Prostate Cancer: Research to Improve Screening, Diagnosis, Staging and Treatment

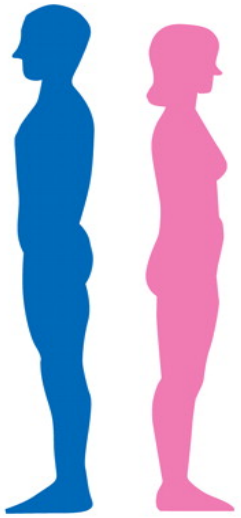
Peter A. Pinto, M.D.

Tenure Track Investigator
Head, Prostate Cancer Section
Urologic Oncology Branch
Center for Cancer Research
National Cancer Institute
National Institutes of Health

May 6, 2014

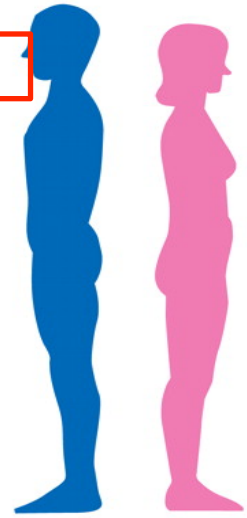
Estimated New Cases*

Males			Females		
Prostate	217,730	28%	Breast	207,090	28%
Lung & bronchus	116,750	15%	Lung & bronchus	105,770	14%
Colon & rectum	72,090	9%	Colon & rectum	70,480	10%
Urinary bladder	52,760	7%	Uterine corpus	43,470	6%
Melanoma of the skin	38,870	5%	Thyroid	33,930	5%
Non-Hodgkin lymphoma	35,380	4%	Non-Hodgkin lymphoma	30,160	4%
Kidney & renal pelvis	35,370	4%	Melanoma of the skin	29,260	4%
Oral cavity & pharynx	25,420	3%	Kidney & renal pelvis	22,870	3%
Leukemia	24,690	3%	Ovary	21,880	3%
Pancreas	21,370	3%	Pancreas	21,770	3%
All Sites	**789,620**	**100%**	**All Sites**	**739,940**	**100%**



Estimated Deaths

Males			Females		
Lung & bronchus	86,220	29%	Lung & bronchus	71,080	26%
Prostate	32,050	11%	Breast	39,840	15%
Colon & rectum	26,580	9%	Colon & rectum	24,790	9%
Pancreas	18,770	6%	Pancreas	18,030	7%
Liver & intrahepatic bile duct	12,720	4%	Ovary	13,850	5%
Leukemia	12,660	4%	Non-Hodgkin lymphoma	9,500	4%
Esophagus	11,650	4%	Leukemia	9,180	3%
Non-Hodgkin lymphoma	10,710	4%	Uterine Corpus	7,950	3%
Urinary bladder	10,410	3%	Liver & intrahepatic bile duct	6,190	2%
Kidney & renal pelvis	8,210	3%	Brain & other nervous system	5,720	2%
All Sites	**299,200**	**100%**	**All Sites**	**270,290**	**100%**



PCa Screening

"Prostate cancer is a serious health problem that affects thousands of men and their families. But before getting a PSA test, all men deserve to know what the science tells us about PSA screening: there is a very small potential benefit and significant potential harms. We encourage clinicians to consider this evidence and not screen their patients with a PSA test unless the individual being screened understands what is known about PSA screening and makes the personal decision that even a *small possibility of benefit outweighs the known risk of harms*." Grade D recommendation

USPSTF Co-Chair Michael LeFevre, M.D., M.S.P.H.
May 22, 2012

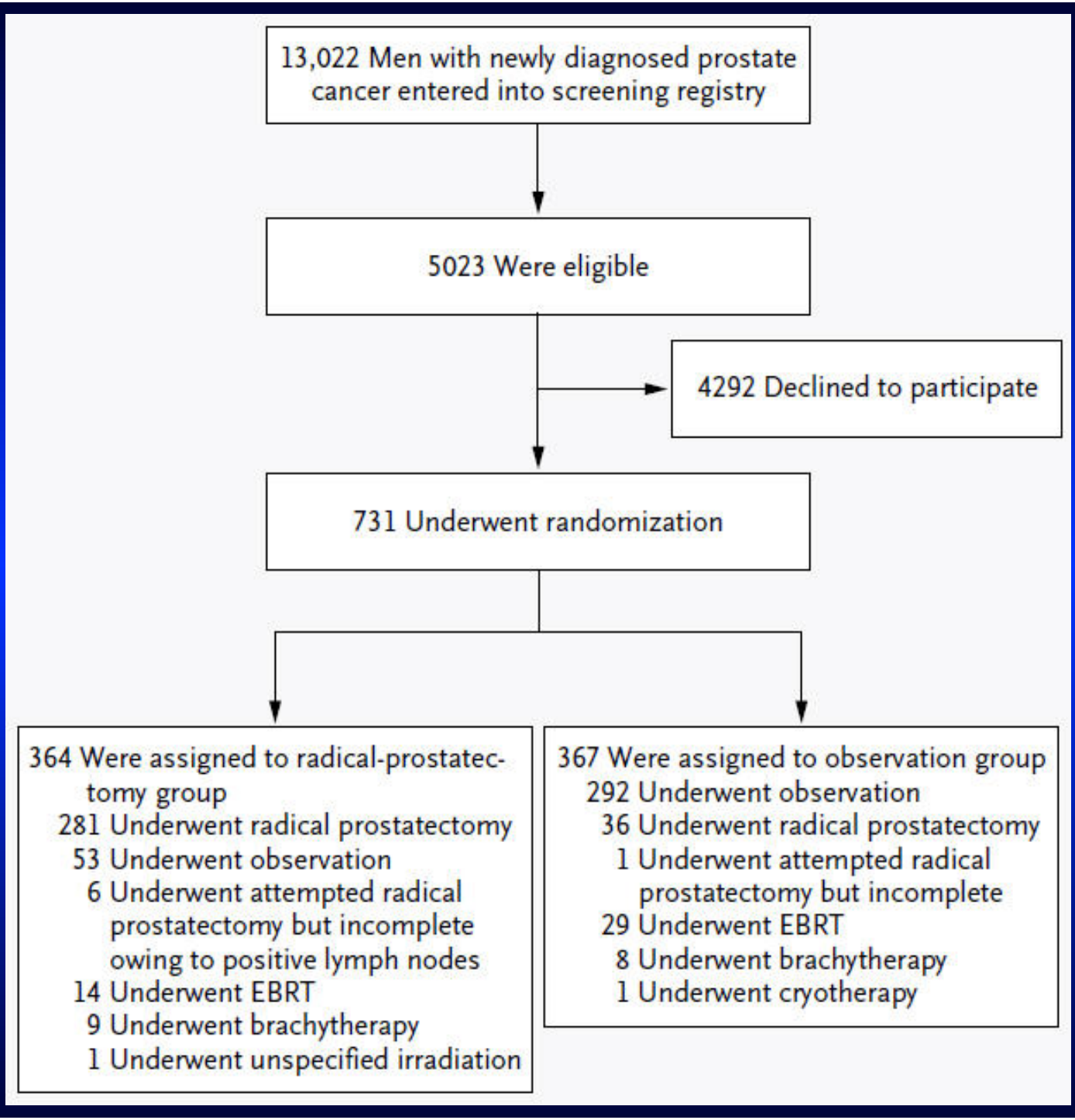
The NEW ENGLAND JOURNAL of MEDICINE

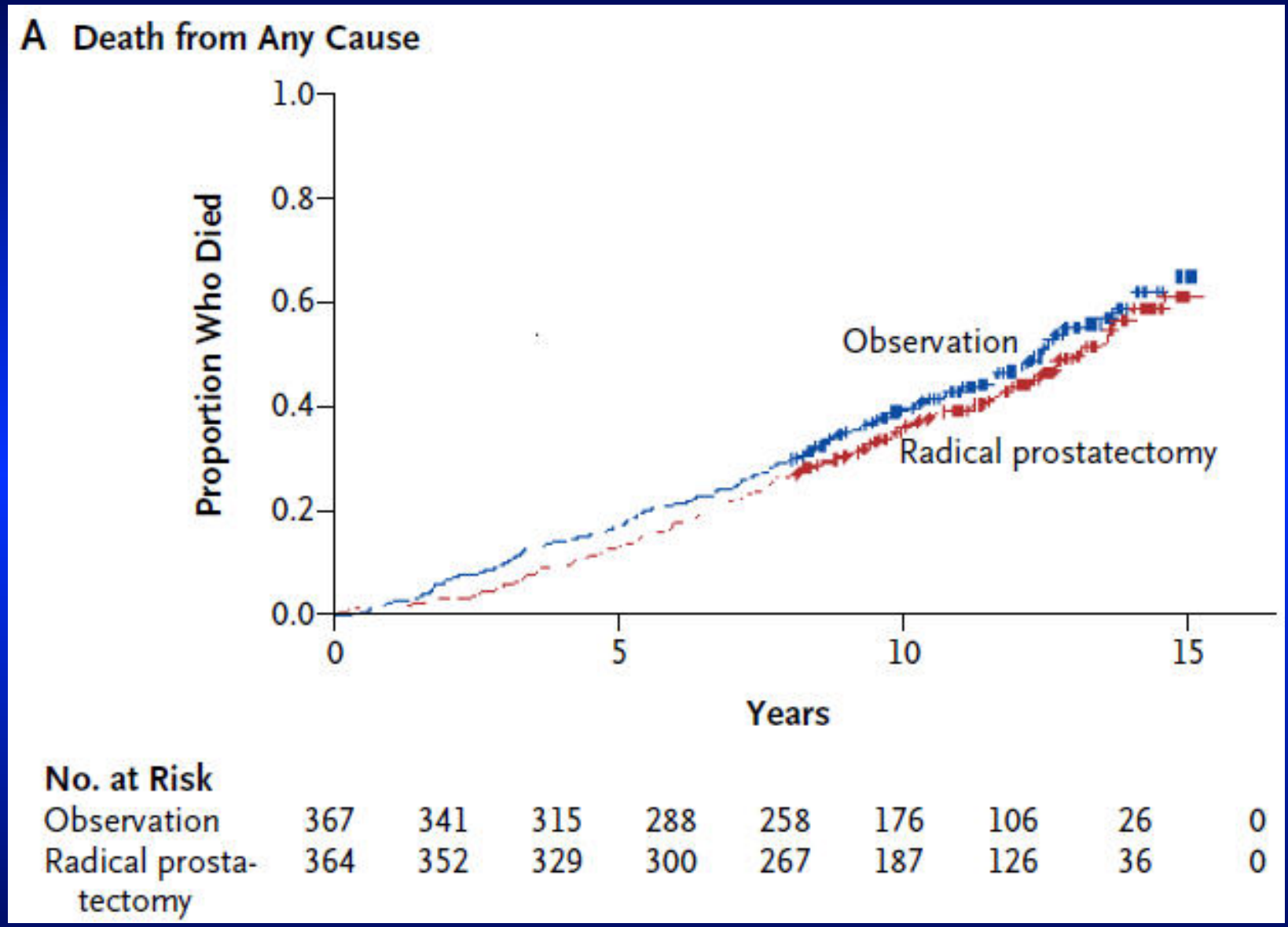
ESTABLISHED IN 1812 JULY 19, 2012 VOL. 367 NO. 3

Radical Prostatectomy versus Observation for Localized Prostate Cancer

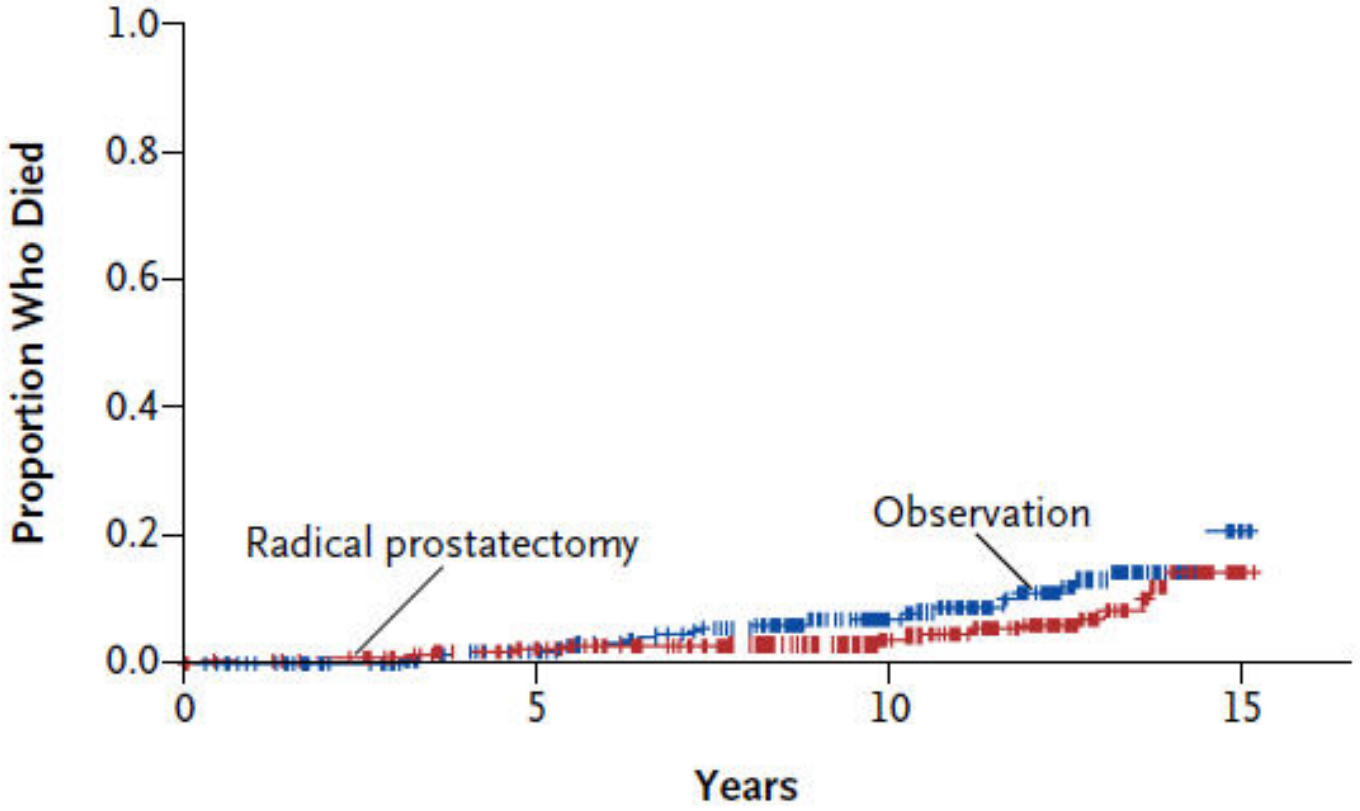
Timothy J. Wilt, M.D., M.P.H., Michael K. Brawer, M.D., Karen M. Jones, M.S., Michael J. Barry, M.D., William J. Aronson, M.D., Steven Fox, M.D., M.P.H., Jeffrey R. Gingrich, M.D., John T. Wei, M.D., Patricia Gilhooly, M.D., B. Mayer Grob, M.D., Imad Nsouli, M.D., Padmini Iyer, M.D., Ruben Cartagena, M.D., Glenn Snider, M.D., Claus Roehrborn, M.D., Ph.D., Roohollah Sharifi, M.D., William Blank, M.D., Parikshit Pandya, M.D., Gerald L. Andriole, M.D., Daniel Culkin, M.D., and Thomas Wheeler, M.D., for the Prostate Cancer Intervention versus Observation Trial (PIVOT) Study Group

Compared to observation, prostatectomy did not significantly improve overall or cancer specific survival over a 12 yr period (PSA era) in localized **low risk** prostate cancer


13,022 Men with newly diagnosed prostate cancer entered into screening registry
5023 Were eligible
4292 Declined to participate
731 Underwent randomization
364 Were assigned to radical-prostatectomy group
281 Underwent radical prostatectomy
53 Underwent observation
6 Underwent attempted radical prostatectomy but incomplete owing to positive lymph nodes
14 Underwent EBRT
9 Underwent brachytherapy
1 Underwent unspecified irradiation
367 Were assigned to observation group
292 Underwent observation
36 Underwent radical prostatectomy
1 Underwent attempted radical prostatectomy but incomplete
29 Underwent EBRT
8 Underwent brachytherapy
1 Underwent cryotherapy


A Death from Any Cause
Proportion Who Died
1.0
0.8
0.6
0.4
0.2
0.0
0
5
10
15
Years
Observation
Radical prostatectomy
No. at Risk
Observation 367 341 315 288 258 176 106 26 0
Radical prostatectomy 364 352 329 300 267 187 126 36 0

B **Death from Prostate Cancer**



No. at Risk

Observation	367	341	315	288	258	176	106	26	0
Radical prostatectomy	364	352	329	300	267	187	126	36	0

Table 2. Patient-Reported Urinary, Erectile, and Bowel Dysfunction at 2 Years, According to Study Group.*

Dysfunction	Radical Prostatectomy	Observation	P Value
	no./total no. (%)		
Urinary incontinence†	49/287 (17.1)	18/284 (6.3)	<0.001
Erectile dysfunction‡	231/285 (81.1)	124/281 (44.1)	<0.001
Bowel dysfunction§	35/286 (12.2)	32/282 (11.3)	0.74

Summary

- Do not screen for prostate cancer with PSA
- When cancer discovered do not treat
- Is this the death of an entire medical specialty ?

How does a physician screen and detect prostate cancer ?

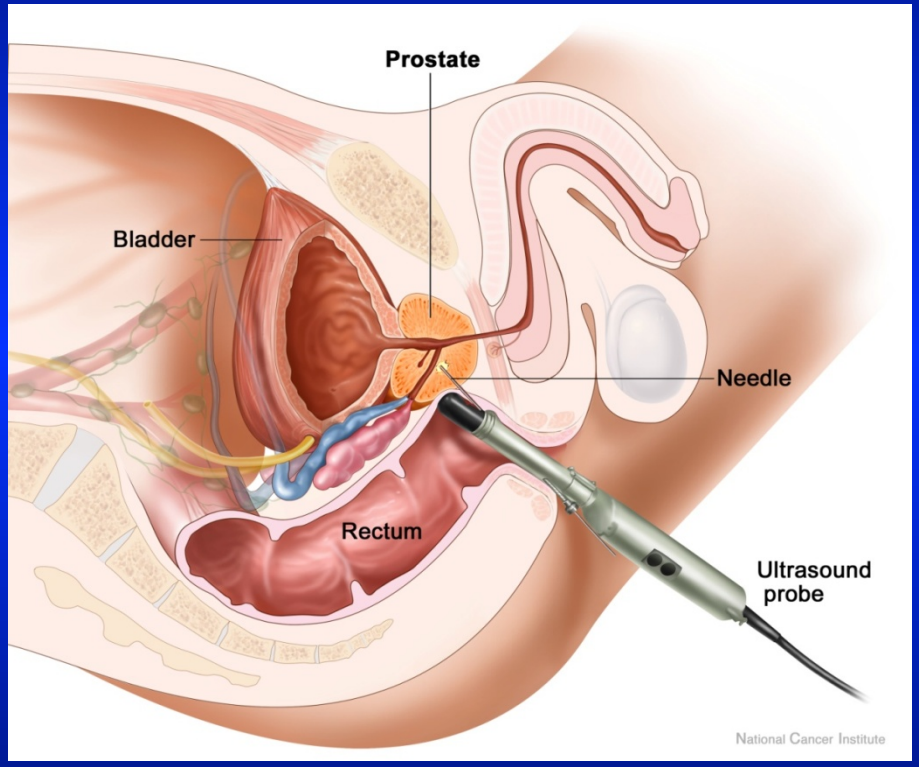
- DRE and **PSA**
- PSA leads to a blind, random 12 core prostate biopsy in the hopes you hit the cancer
- Often miss the lethal tumors and detect insignificant cancer

How does a physician screen and detect prostate cancer ?

- Prostate cancer is the only solid-organ tumor currently diagnosed without routine imaging in the hopes of accidentally “hitting” the tumor

Prostate Cancer Detection Rate

- 6 core biopsy
  - 20 to 30%
- 12 core biopsy
  - 27 to 40%



Wein et. al. Campbell-Walsh Urology. 9th ed. Philadelphia, PA. 2007.

When the biopsy is negative ?

- “Physicians are frequently presented with the dilemma of a patient who has had one or more negative prostate biopsies yet continues to have an elevated PSA value or abnormal digital rectal examination of concern for prostate cancer.”

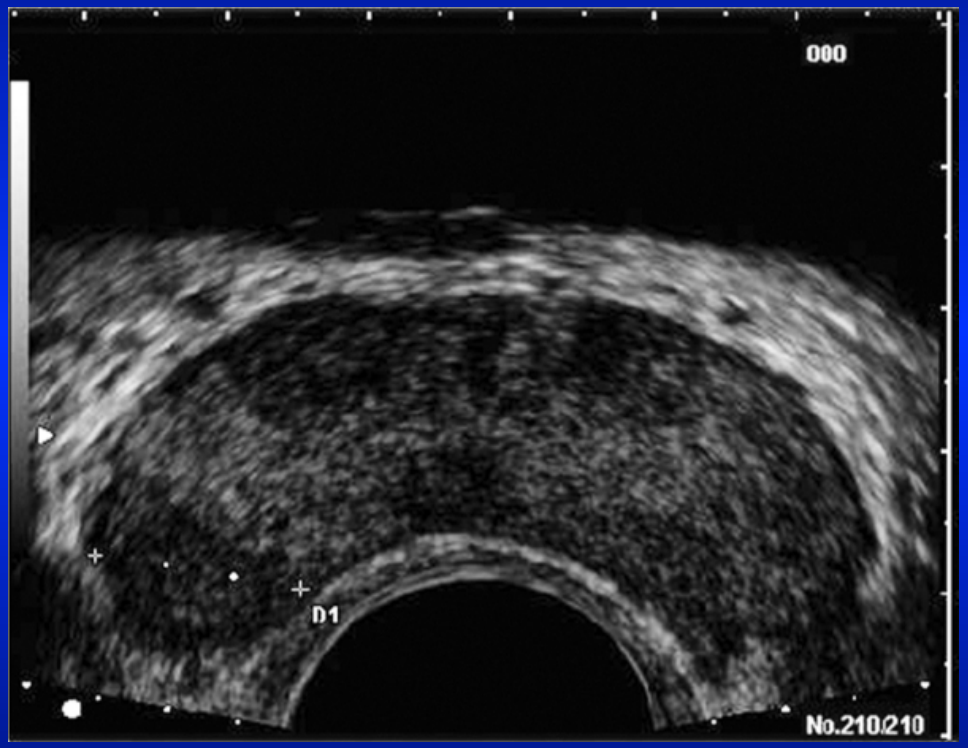
Wein et. al. Campbell-Walsh Urology. 9th ed. 2007:Philadephia, PA

Imaging Cancer

- Other solid tumors are imaged and biopsied directed into the tumor
- Where was imaging for prostate cancer?

Trans Rectal Ultrasound (TRUS)

- Few urologists use TRUS to look for areas suspicious for cancer
- 60% of ultrasound-morphologically suspicious lesions are not cancer[1]



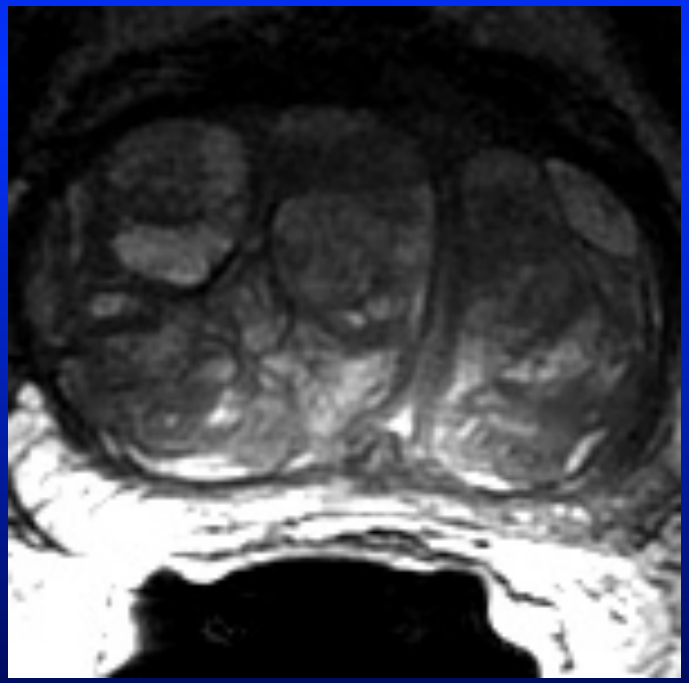
Wein et. al. Campbell-Walsh Urology. 9th ed. 2007:Philadephia, PA

1-Loch, T. et al., Transrectal ultrasound-guided biopsy of the prostate: random sextant versus biopsies of sono-morphologically suspicious lesions, World J. Urol, **22**: 357-360, 2004

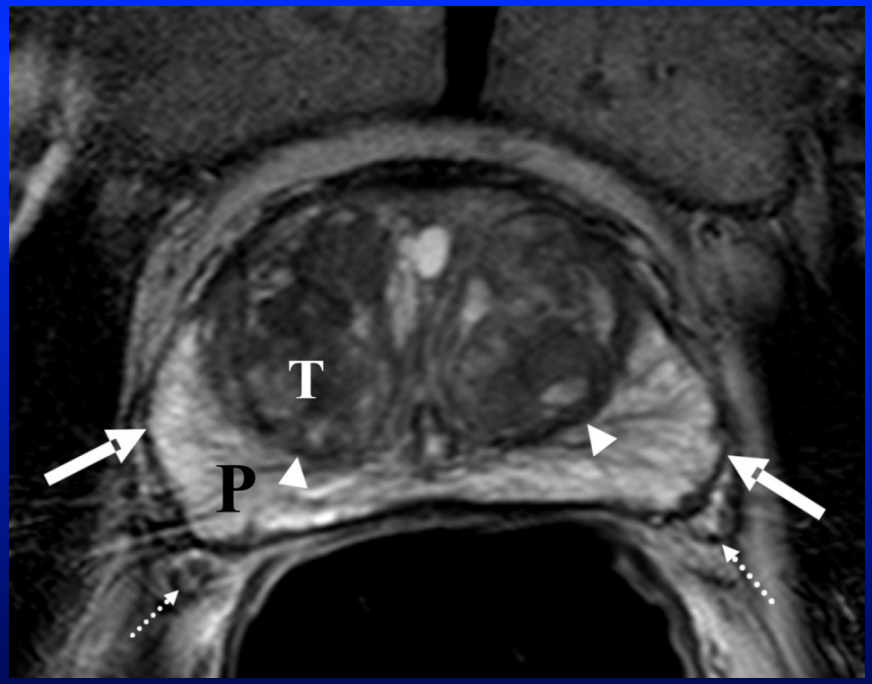
MRI of the Prostate

- High resolution imaging of the prostate

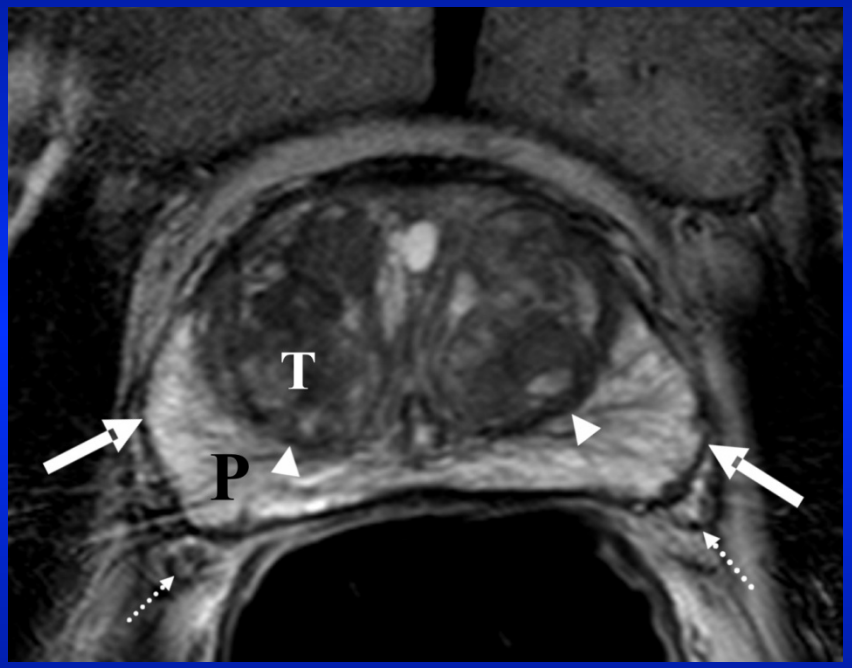
- **Old Technology**

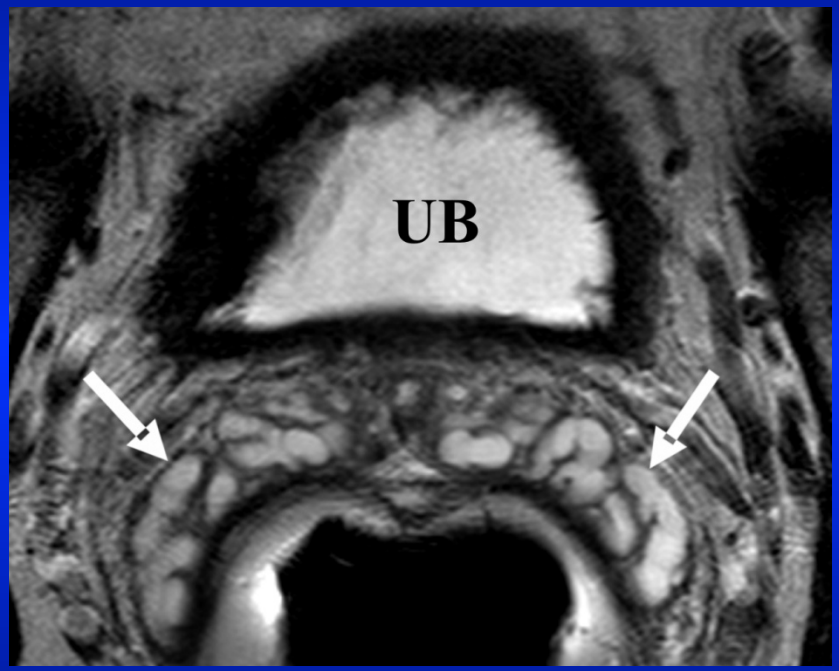


- **New** Technology



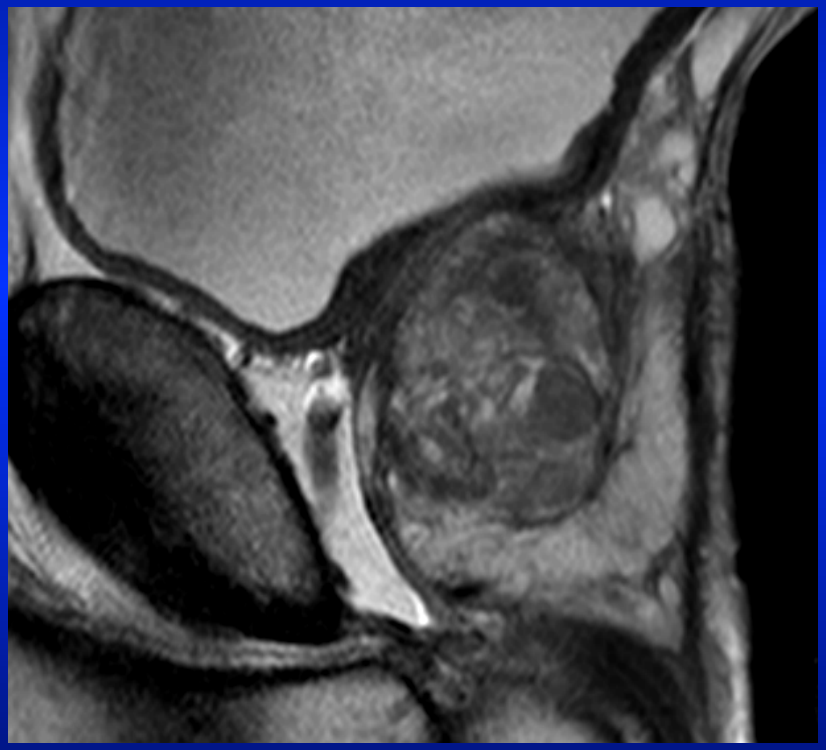
Prostate MRI Anatomy

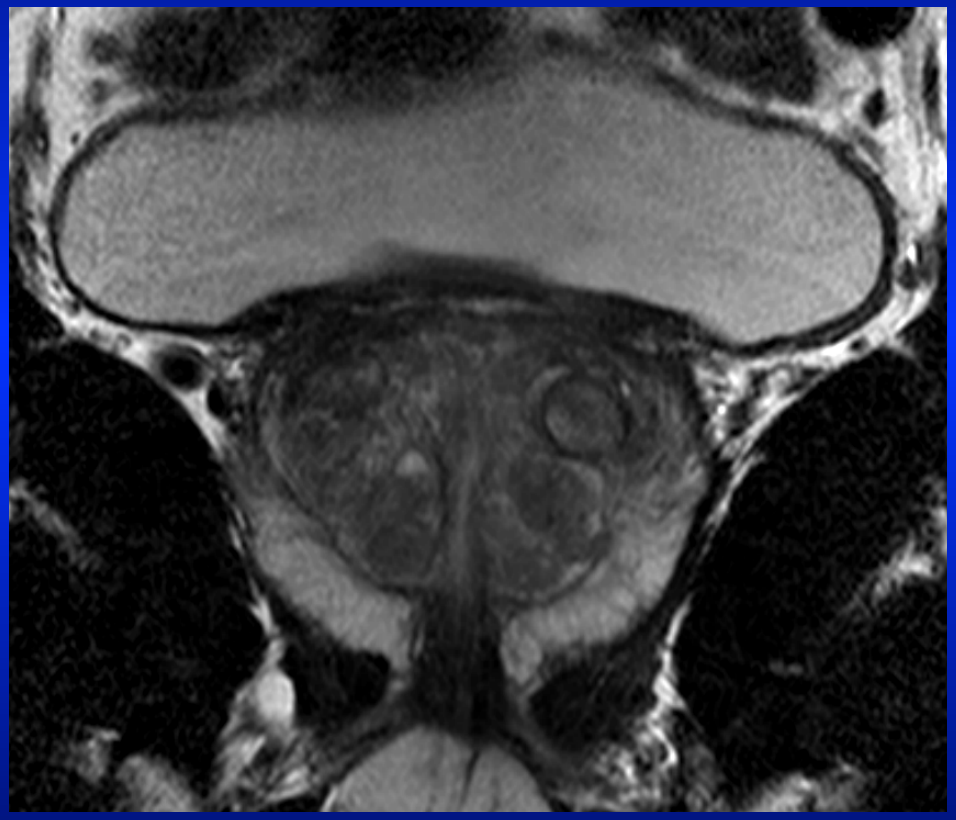




Axial T2 weighted MR images

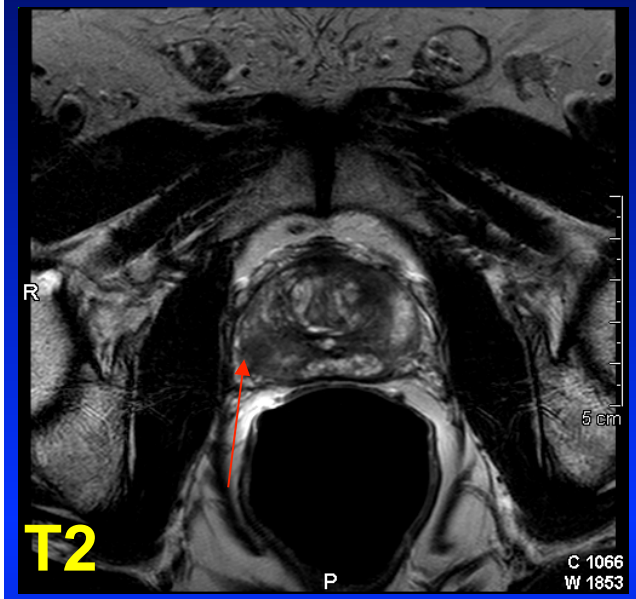
Prostate MRI Anatomy

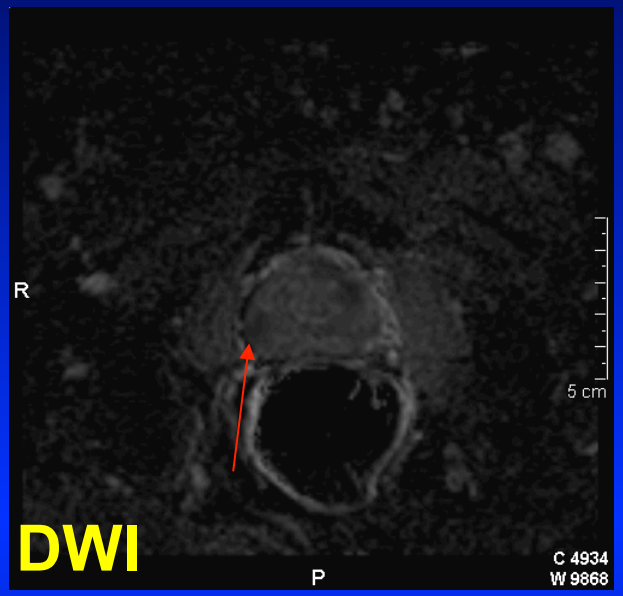


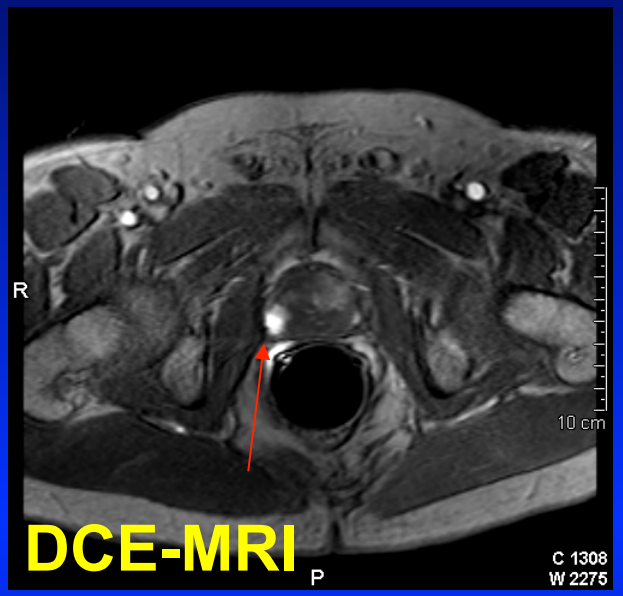


Sagittal and coronal T2 weighted MR images

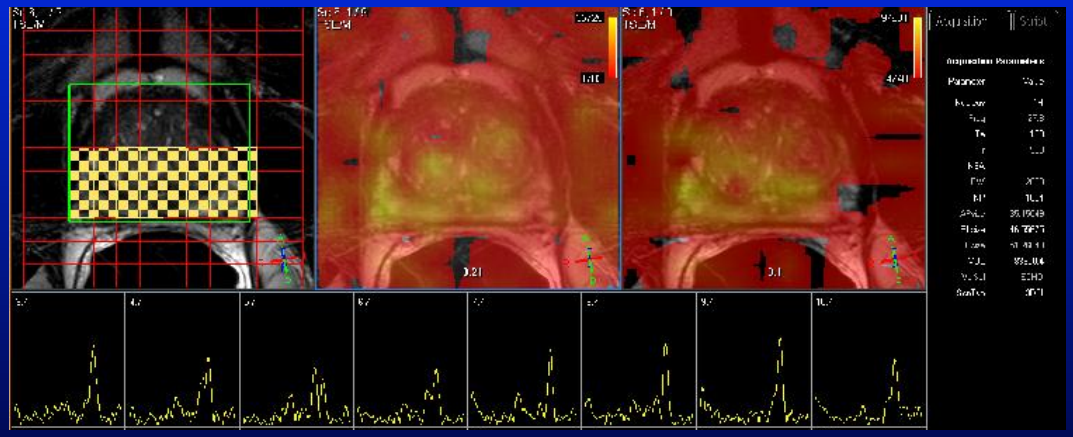
Multi-parametric 3Tesla endorectal MR Imaging of the prostate







Spectroscopy



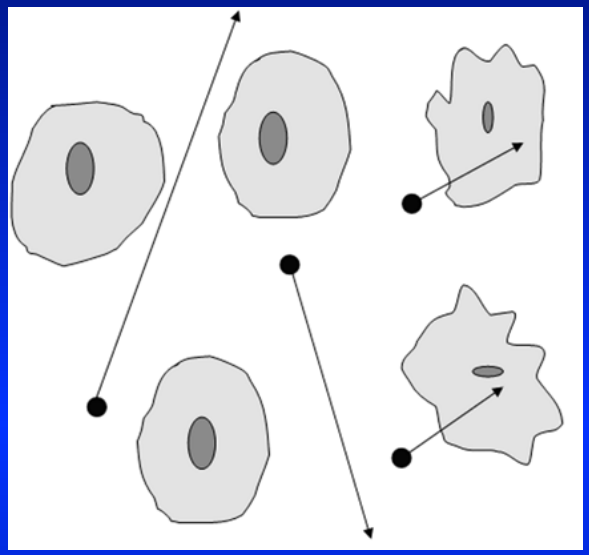
Multiparametric Prostate MRI

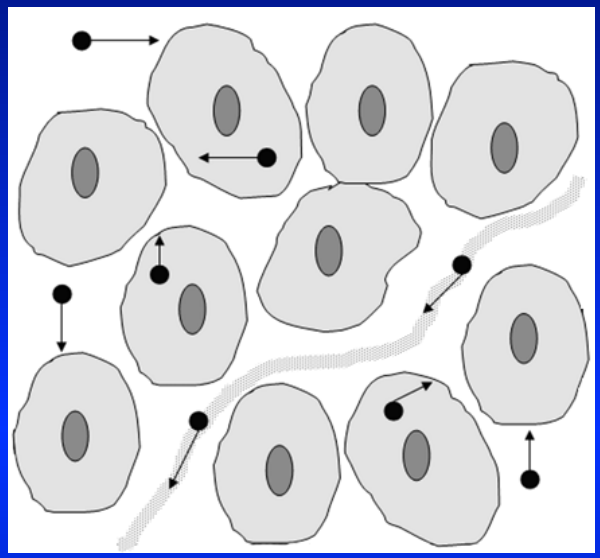
- Magnet Strength
  - 1.5 Tesla vs 3 Tesla
- Coil
  - Endorectal Coil, Body Surface Coil, or Both
- Parameters
  - T2W
  - DWI
  - DCE
  - MRS

Multi-Parametric Prostate MRI

- T2W
- **Diffusion Weighted (DWI- ADC map)**
- DCE-MRI
- MRS

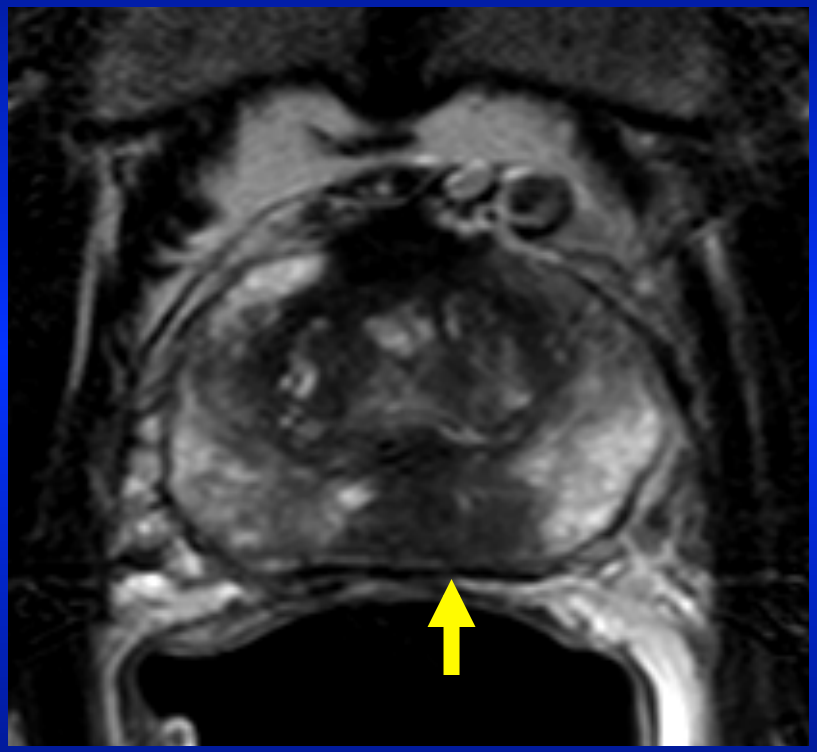
Diffusion Weighted MRI



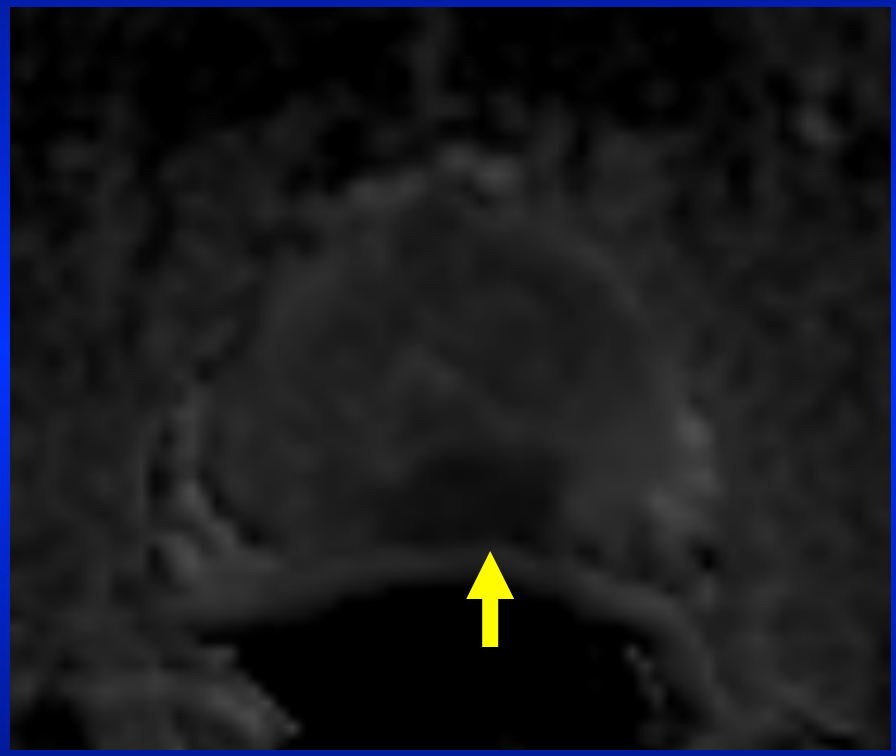


- Evaluates the Brownian motion of free water within tissue
- Tissue diffusion is restricted with
  - increased cellularity
  - indication of prostate cancer
  - can correlate with gleason grade

53 y.o. male with a PSA of 20 ng/mL



T2W

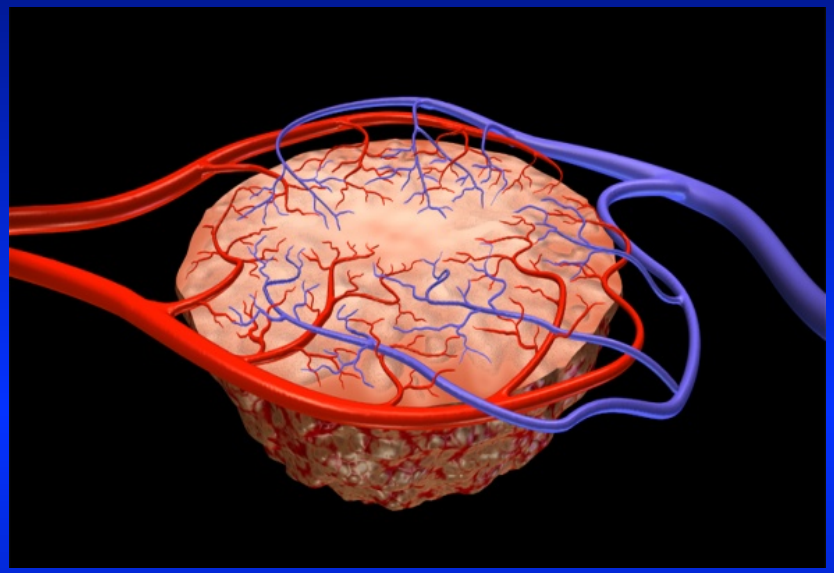


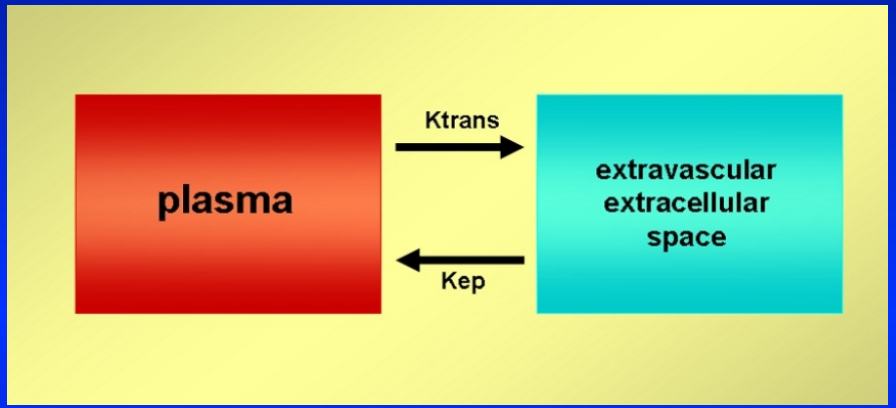
DWI- ADC map

Multi-Parametric Prostate MRI

- T2W
- Diffusion Weighted (DWI- ADC map)
- **Dynamic Contrast Enhanced (DCE)**
- MRS

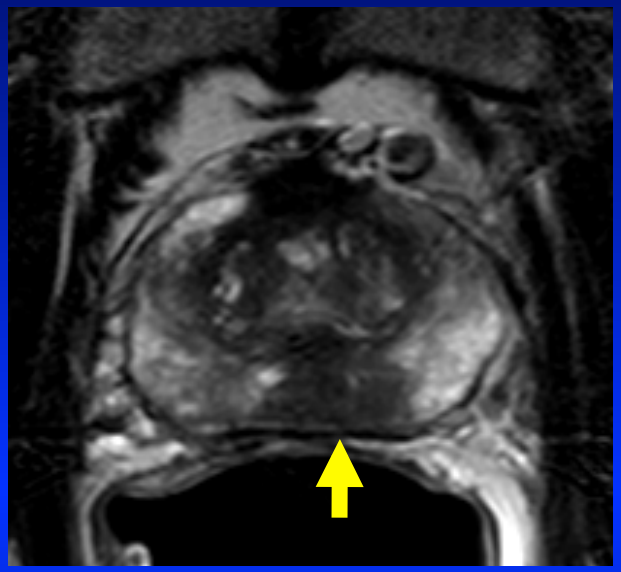
Dynamic Contrast Enhanced (DCE-MRI)



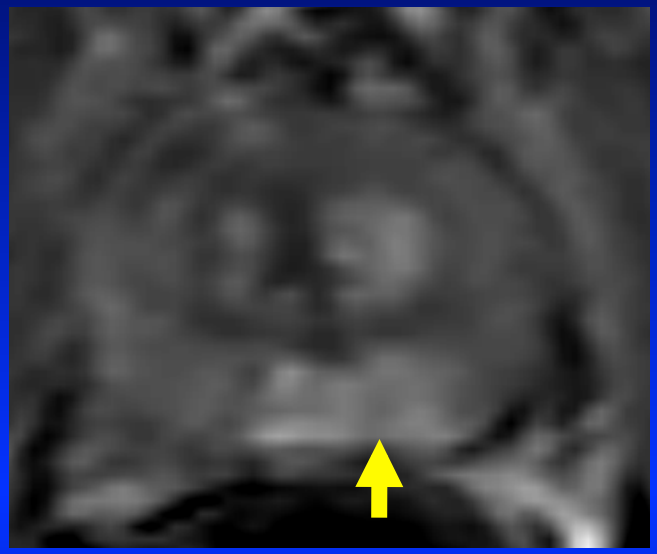


- Evaluates the vascularity of tumors
- Fast MR scanning sequences combined with the rapid administration of LMW Gd
- Prostate cancers show early and rapid enhancement and early washout

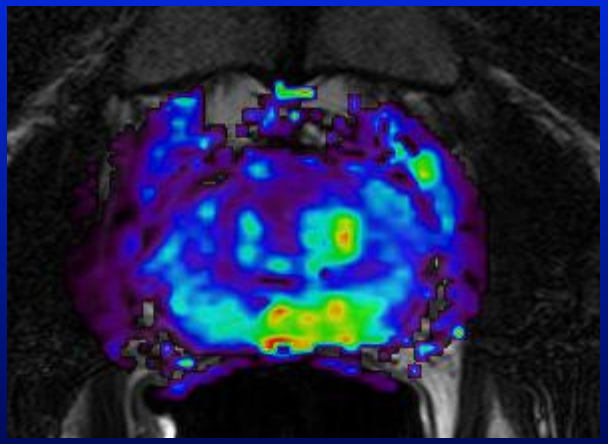
53 y.o. male with a PSA of 20 ng/mL



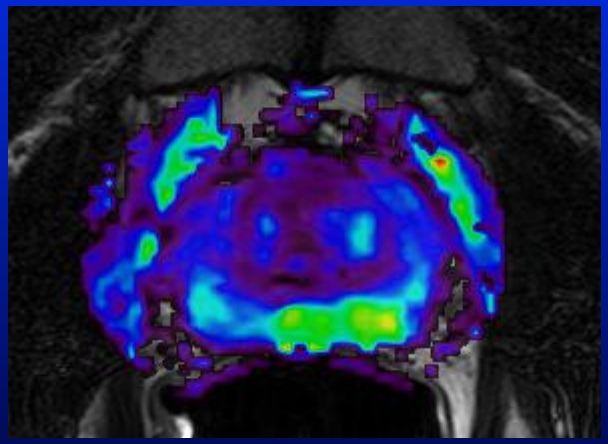
T2 weighted



Raw DCE image



Ktrans map

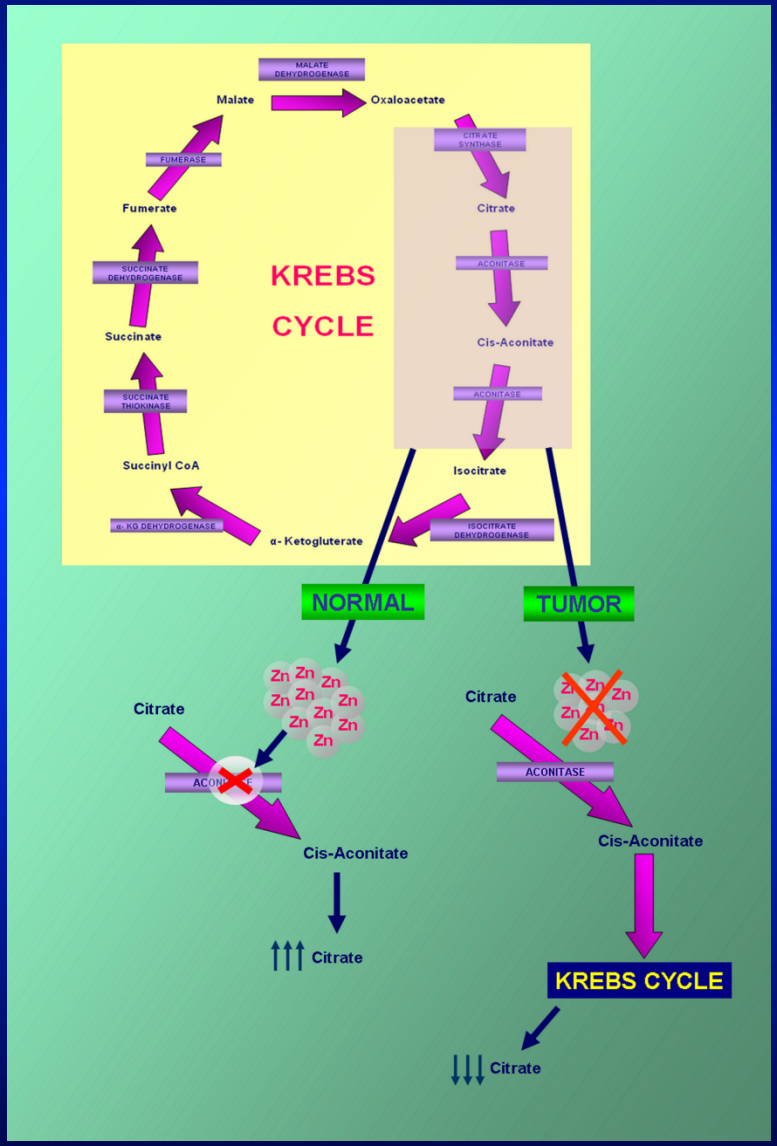


Kep map

Multi-Parametric Prostate MRI

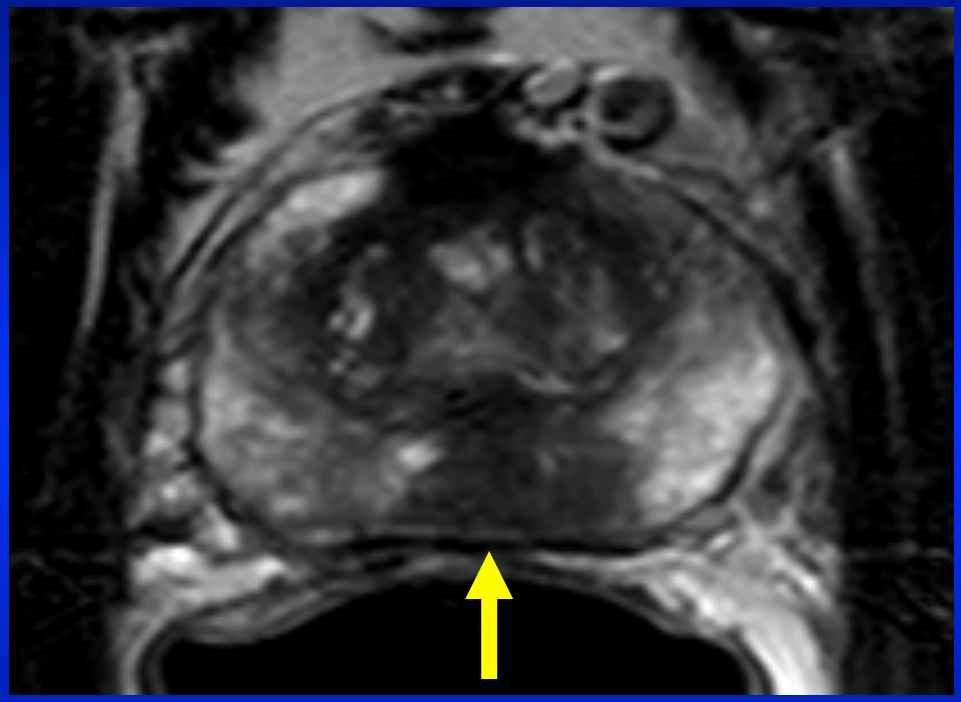
- T2W
- Diffusion Weighted (DWI- ADC map)
- DCE-MRI
- **Spectroscopy (MRS)**

MR Spectroscopy (MRS)

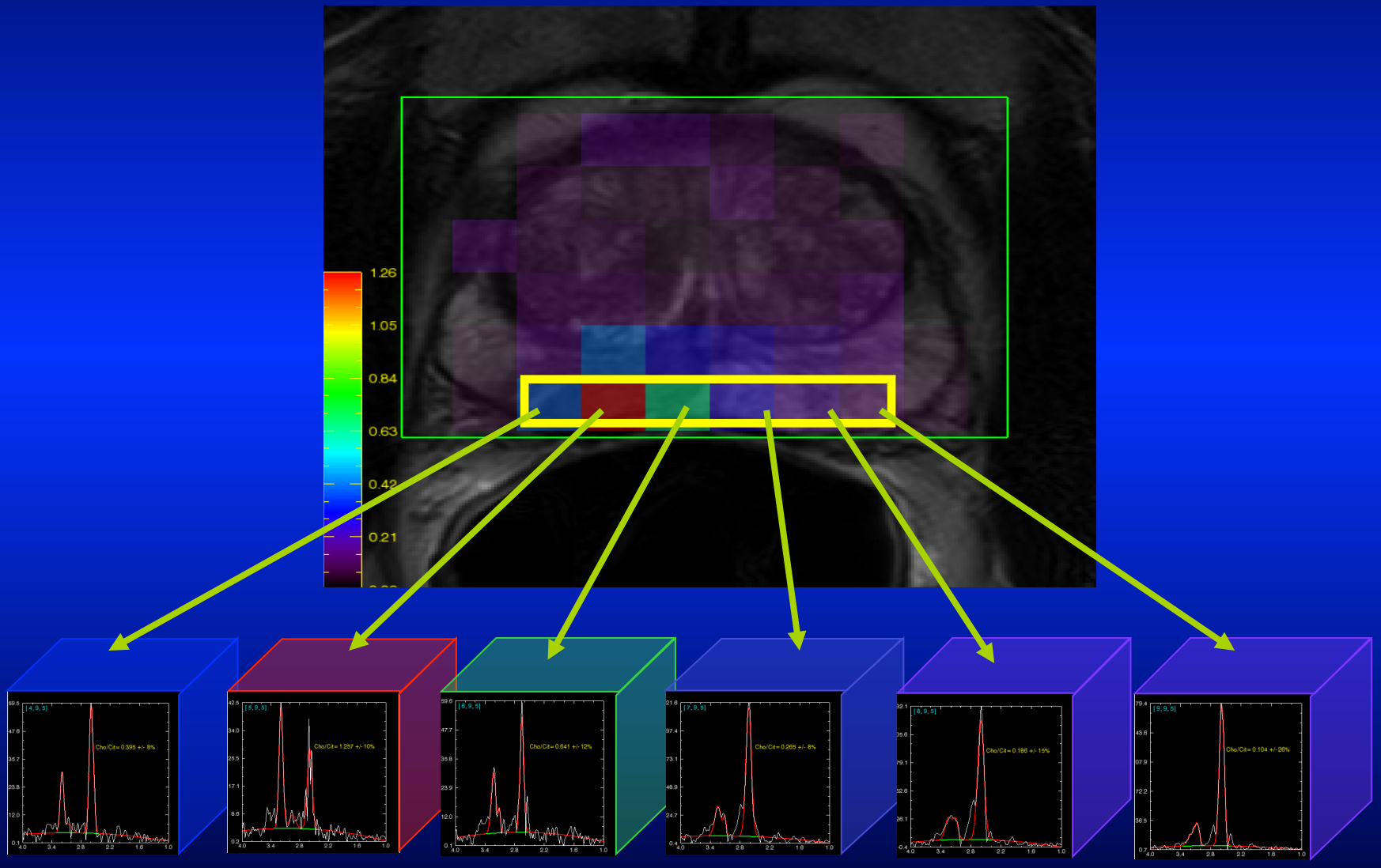


- Provides information about the cellular metabolites within the prostate gland by displaying the relative concentrations of some chemical compounds such as citrate, choline and creatine
- Normal prostate: citrate>>>>choline
- Prostate cancer: citrate↓ choline↑
- ↑choline level is related to increased cell turnover

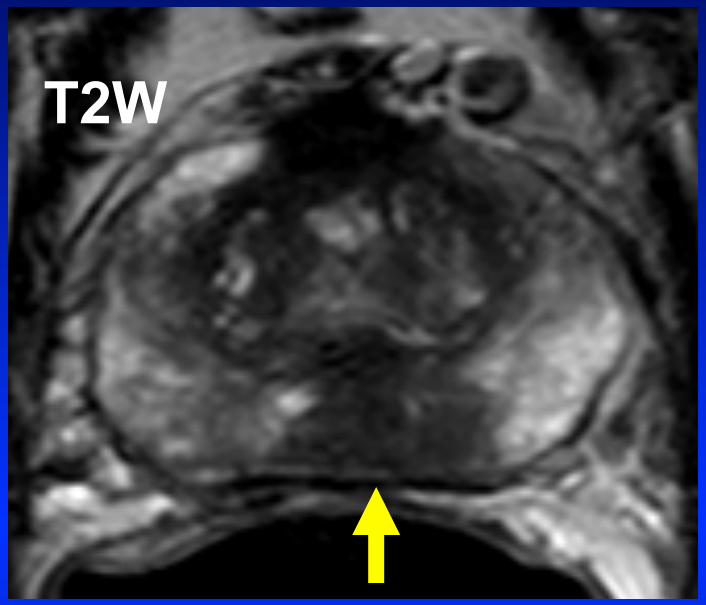
53 y.o. male with a PSA of 20 ng/mL

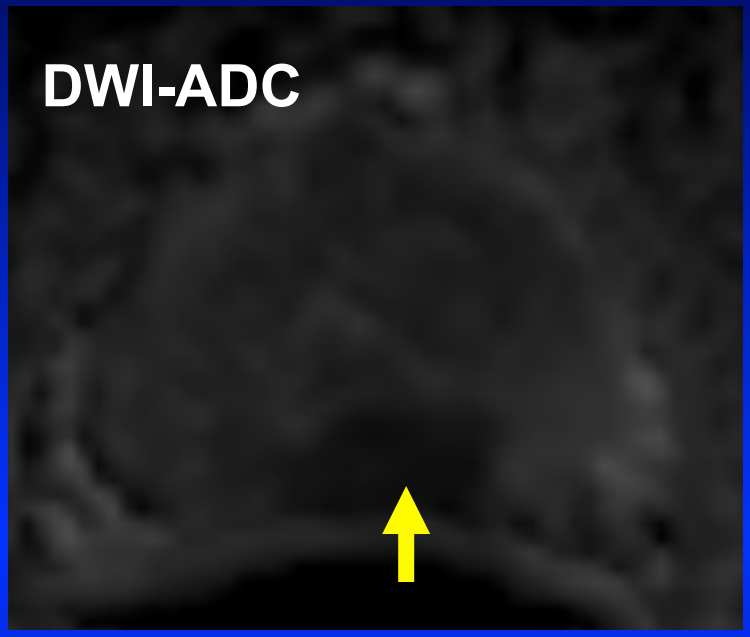


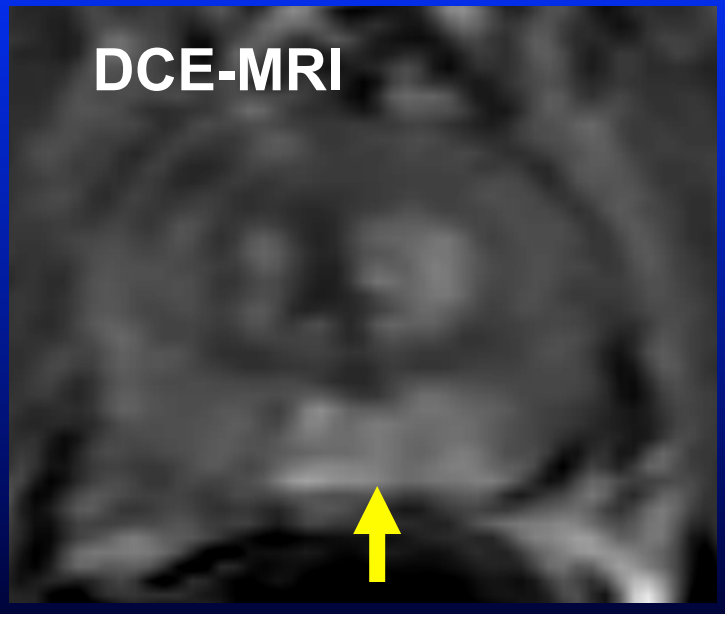
53 y.o. male with a PSA of 20 ng/mL

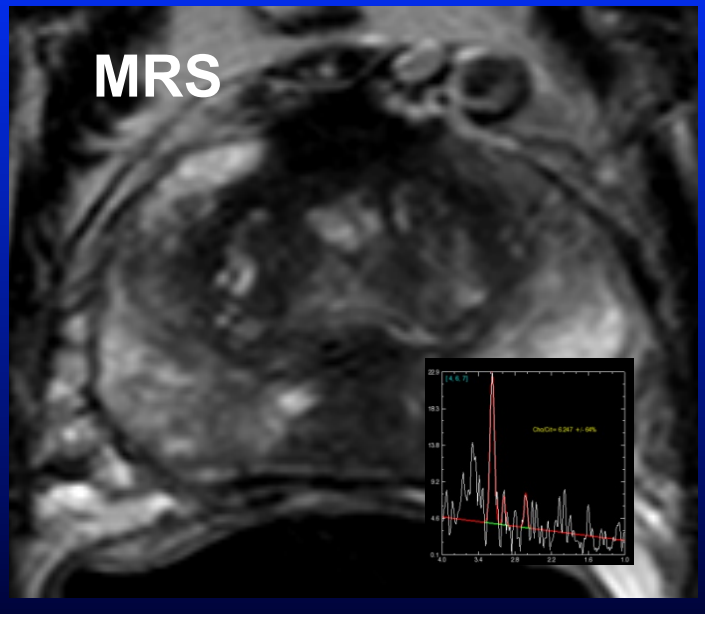


53 y.o. male with a PSA of 20 ng/mL









Findings of MRI modality				Result
T2W	*DWI*	*DCE-MRI*	*MRS*	
–	–	–	–	Negative
+	–	–	–	Low suspicious
–	+	–	–	Low suspicious
+	+	–	–	Low suspicious
+	–	+	–	Low suspicious
+	–	–	+	Low suspicious
–	+	+	–	Low suspicious
–	+	–	+	Low suspicious
+	+	+	–	Moderate suspicious
+	–	+	+	Moderate suspicious
–	+	+	+	Moderate suspicious
+	+	+	+	High suspicious

NIH scoring system used for MRI evaluation

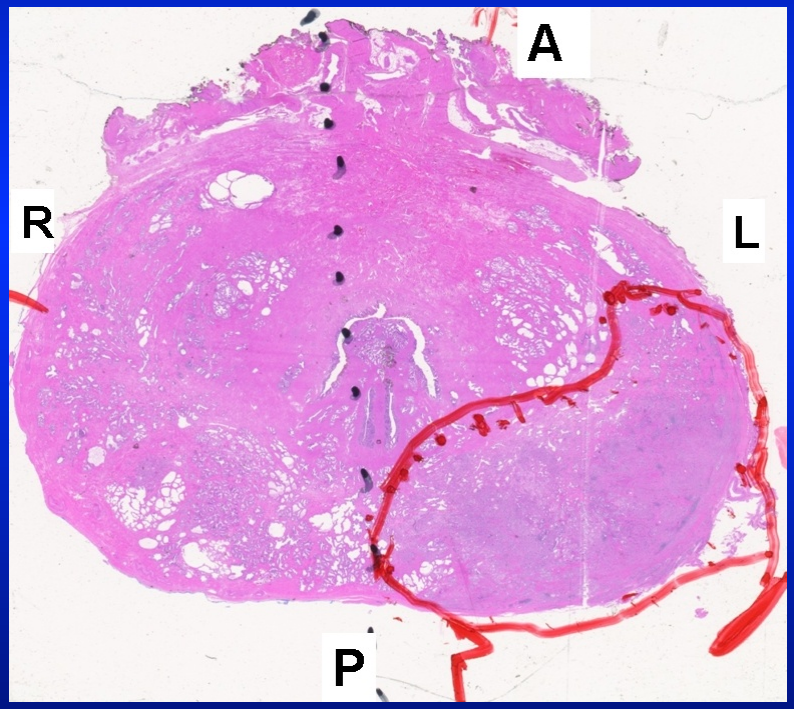
MRI and Histology Correlation for prostate cancer

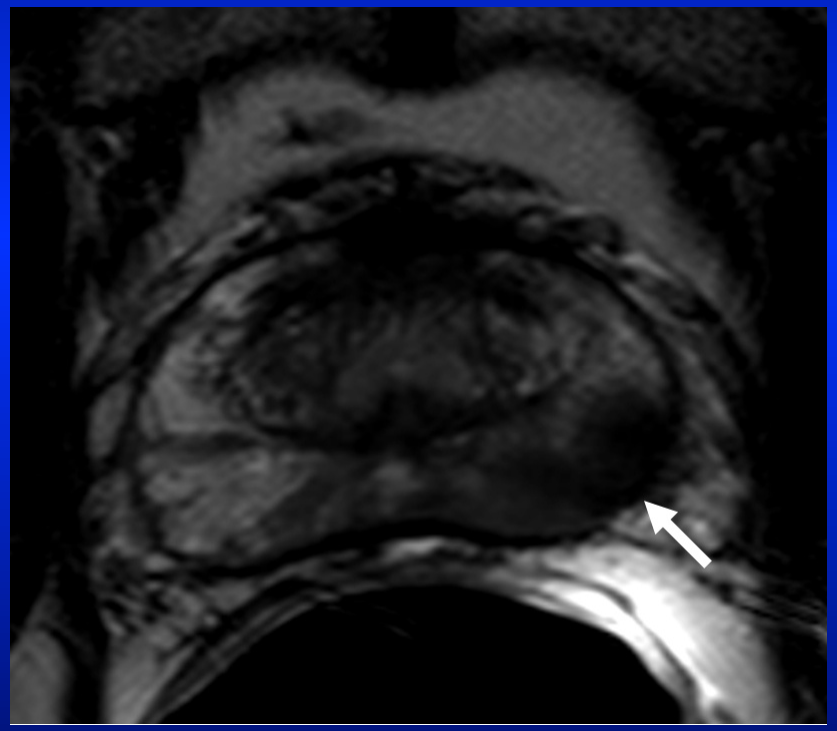
Protocol 04-CC-0109: Comprehensive Prostate MRI for the Evaluation of Prostate Cancer at 3.0T

Men undergo multi-parametric 3T endorectal coil MRI prior to radical prostatectomy

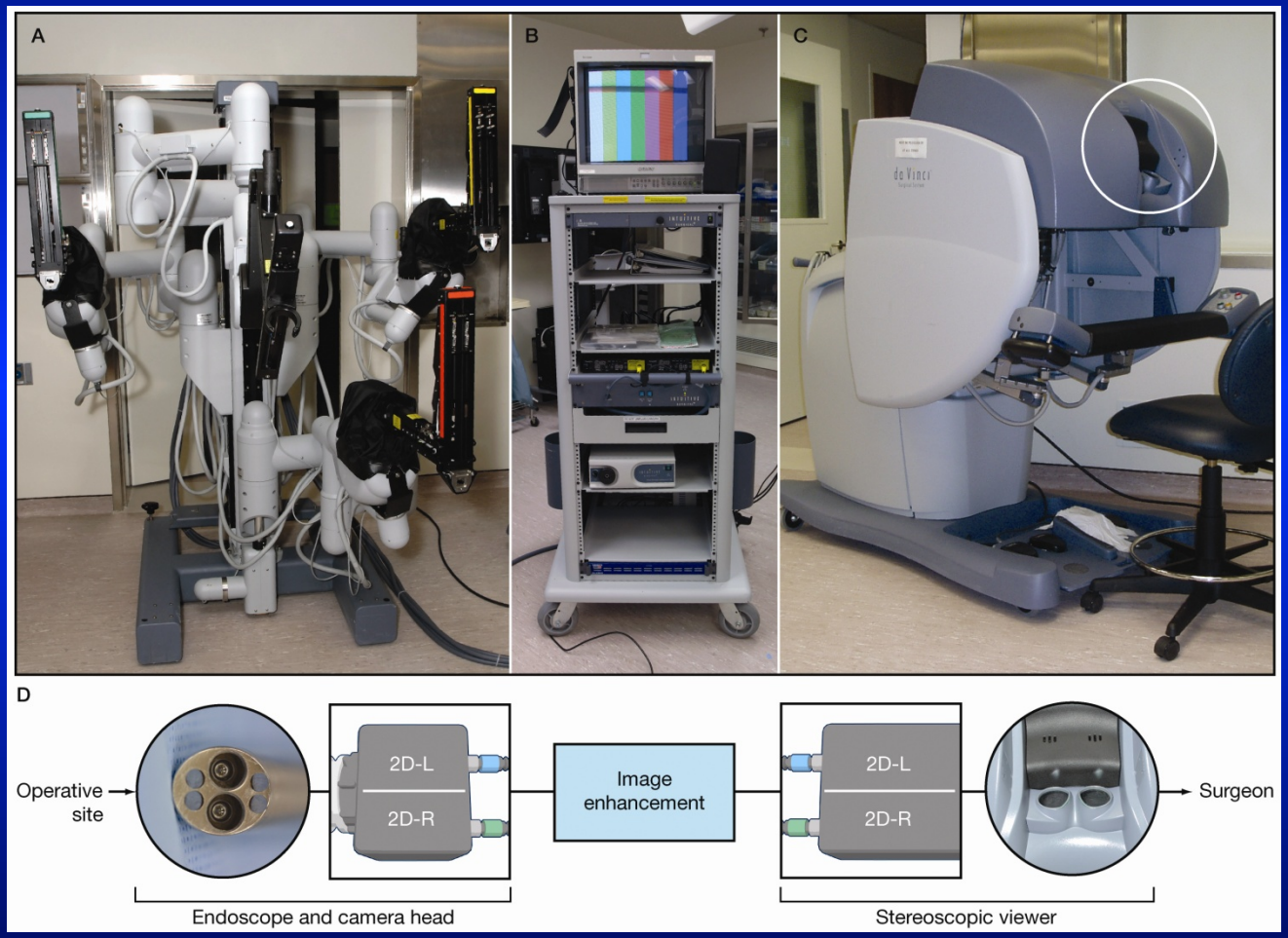
Prostate is whole mount sectioned and compared to MR's axial images

Prostate Cancer Localization with 3T erMRI: Correlation with Whole-Mount Histopathological Specimens



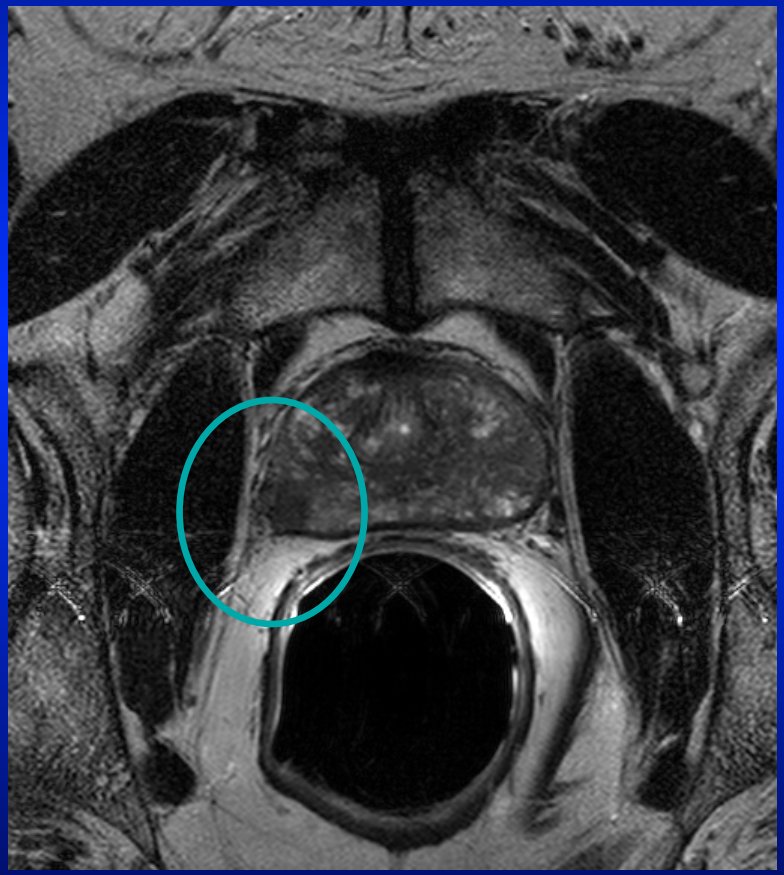


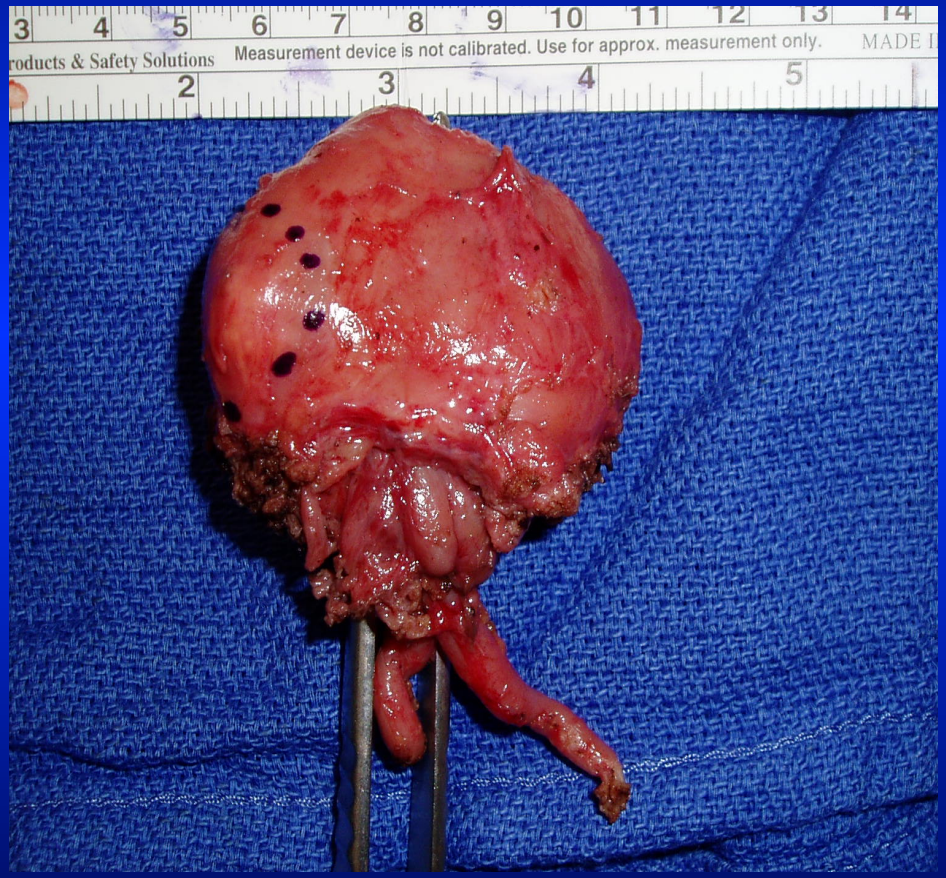
Robotic Radical Prostatectomy



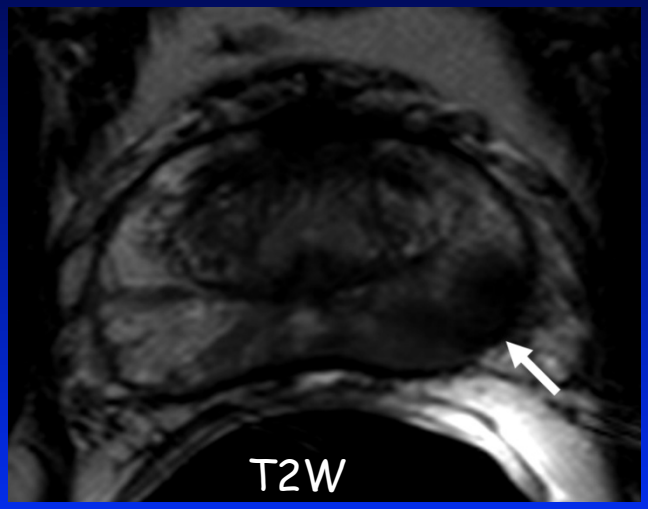
Novakovic, K and Pinto, P. CANCER: Principles and Practice of Oncology, 8th ed.

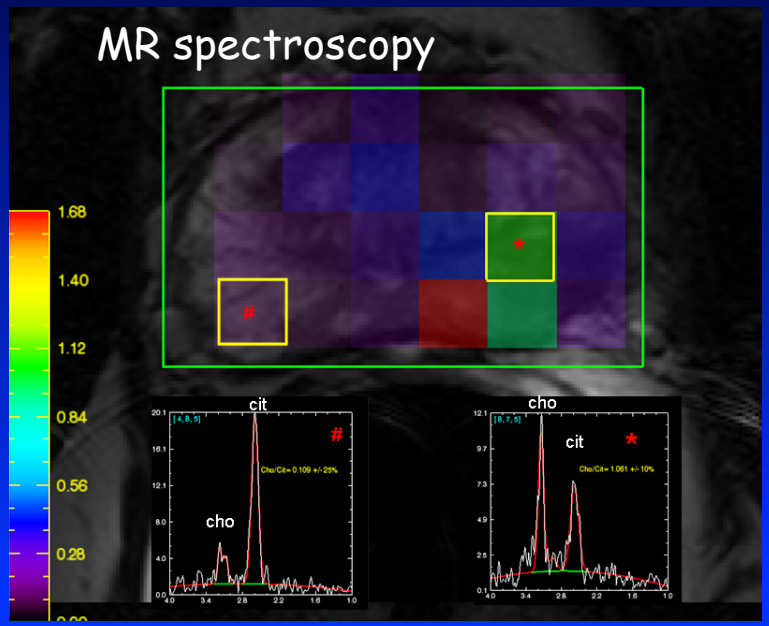
MRI / Path Correlation

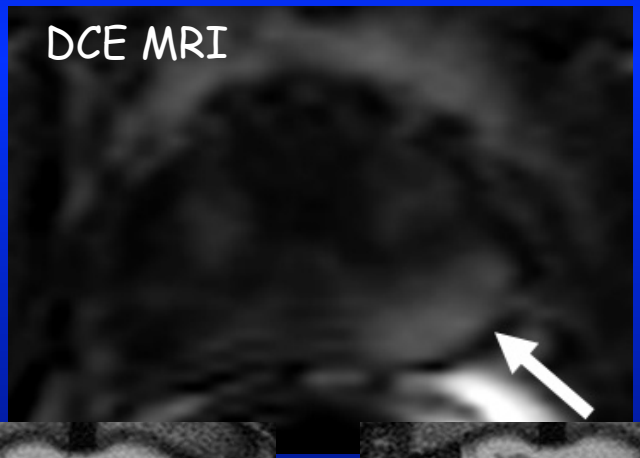


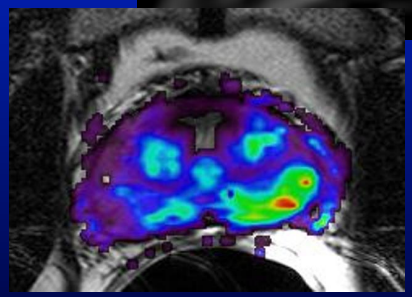


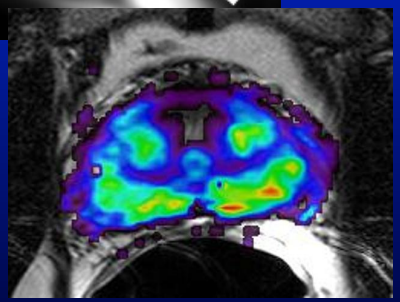
58-year-old male, PSA=7 ng/mL

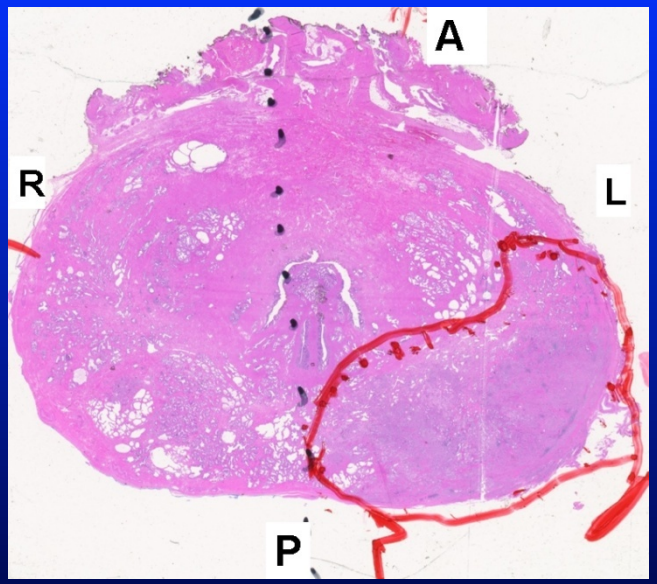




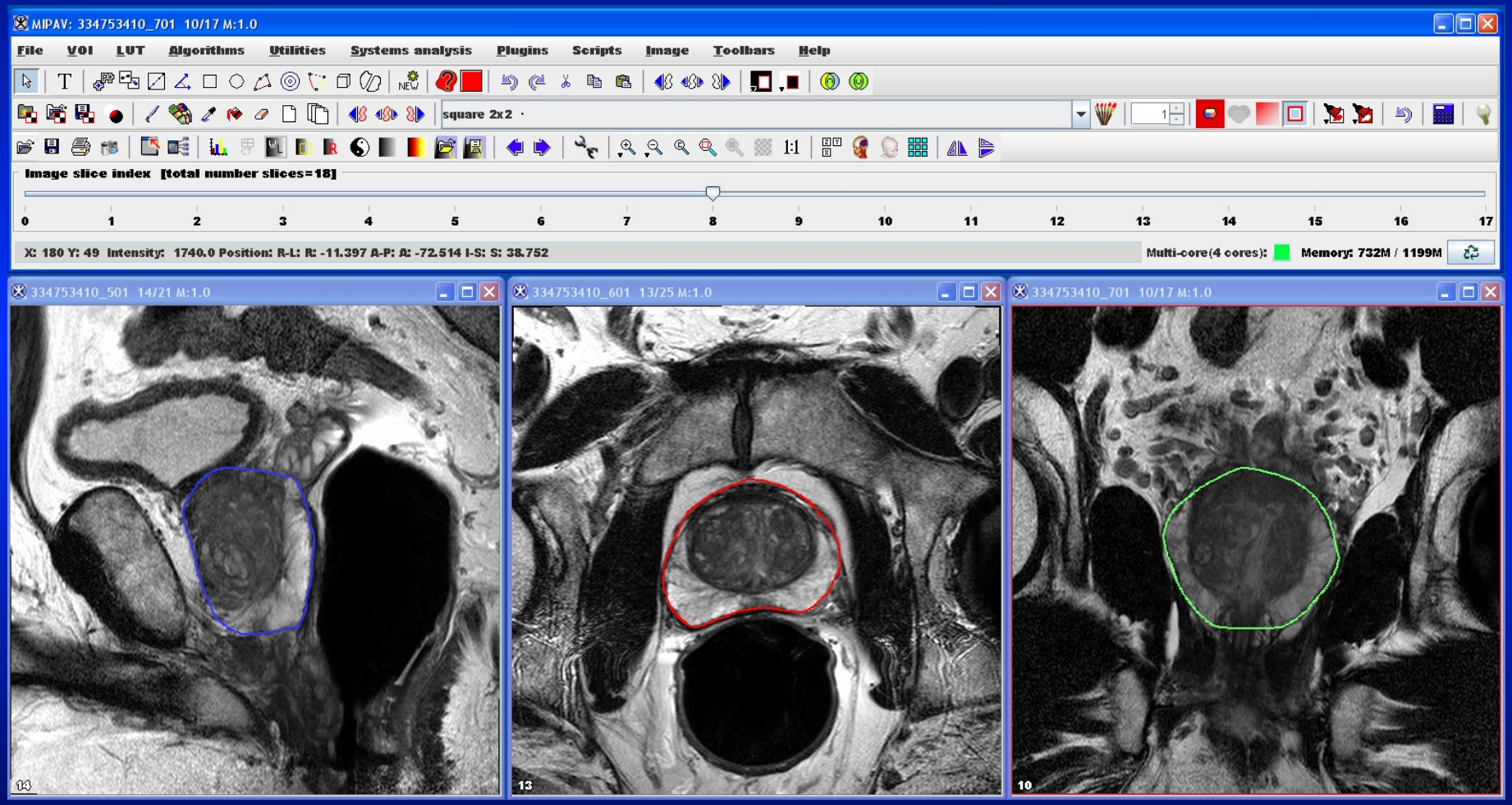




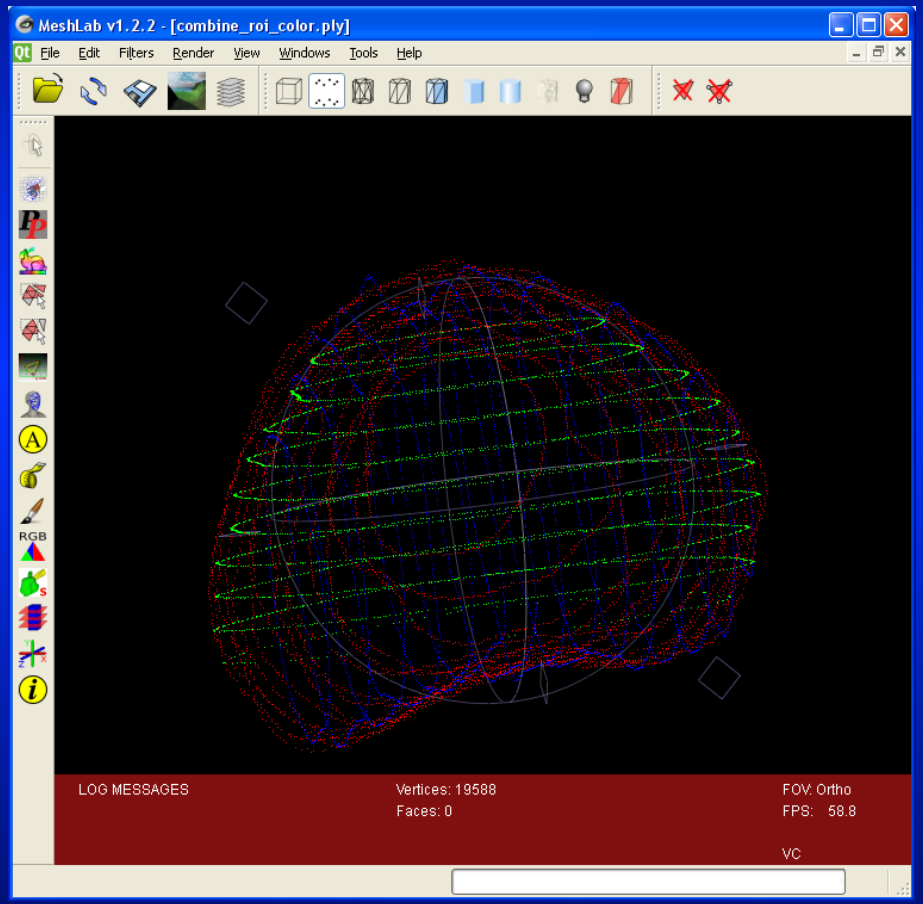


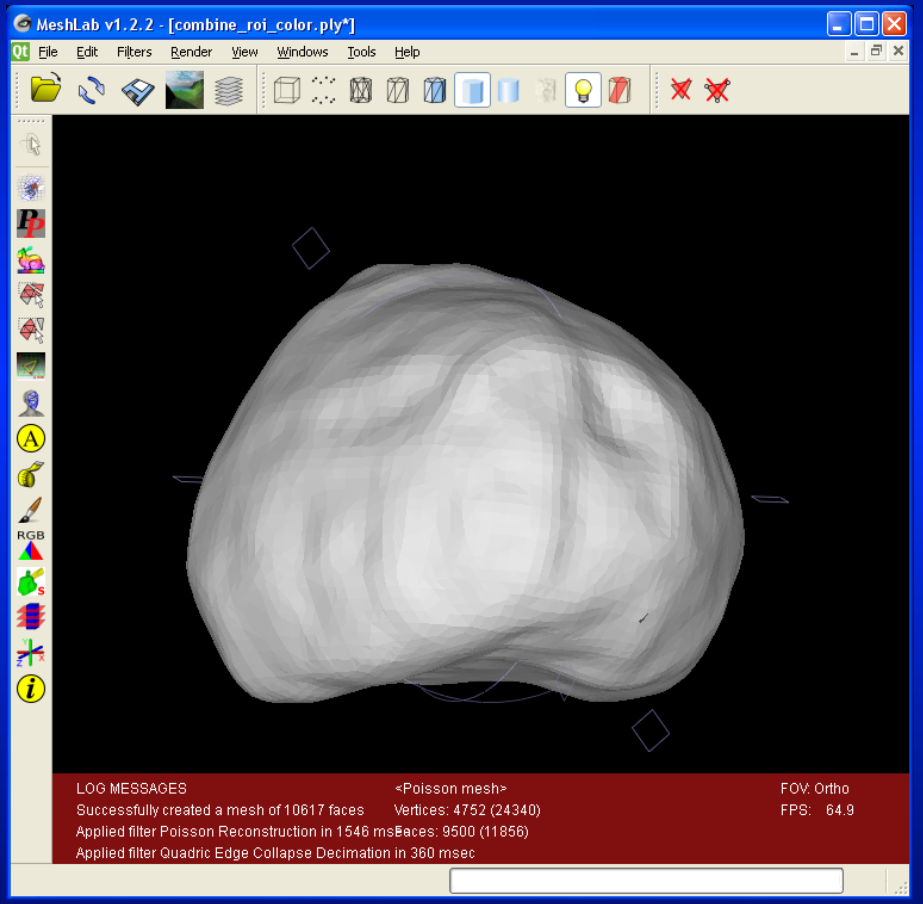


Prostate Segmentation

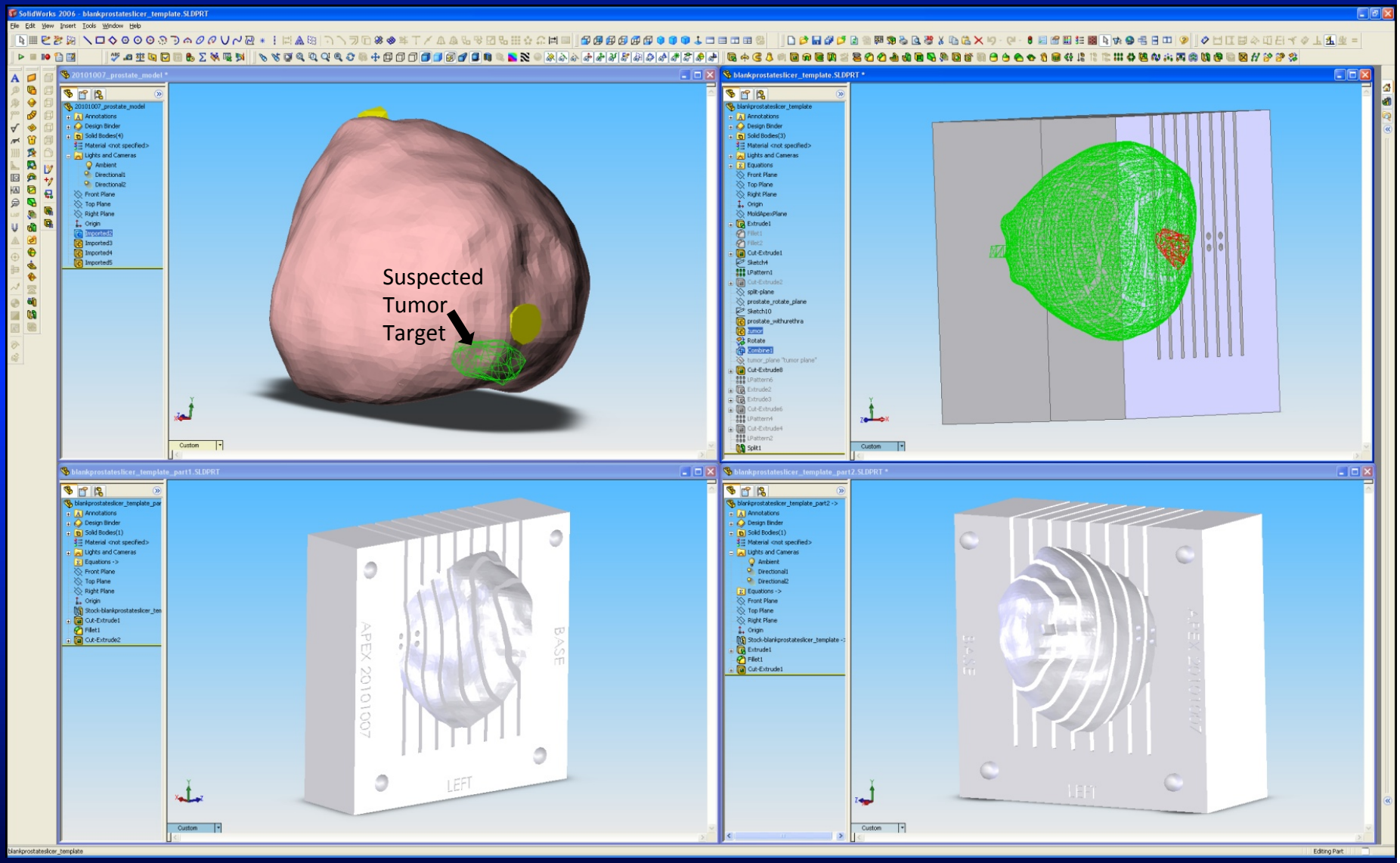


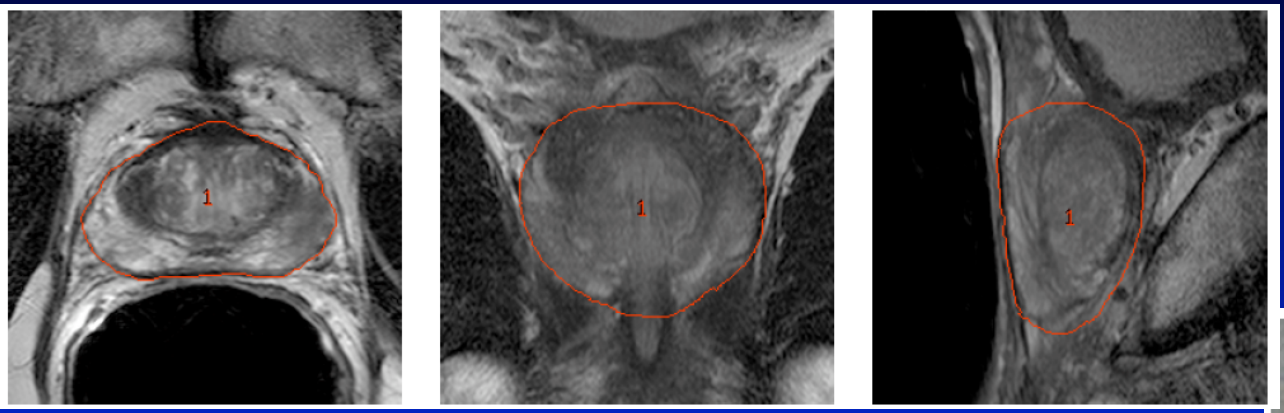
3D Modeling

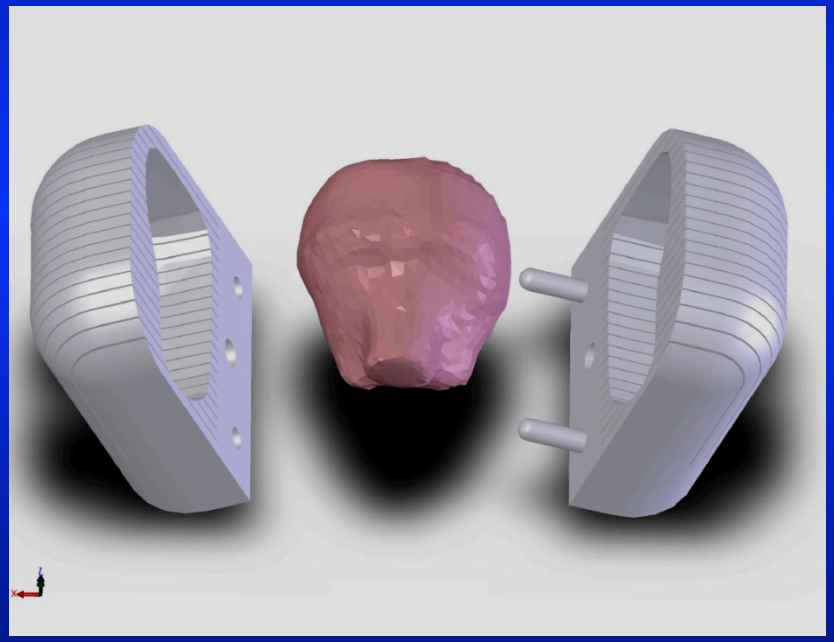

MeshLab v1.2.2 - [combine_roi_color.ply]
File Edit Filters Render View Windows Tools Help
LOG MESSAGES
Vertices: 19588
Faces: 0
FOV: Ortho
FPS: 58.8
VC

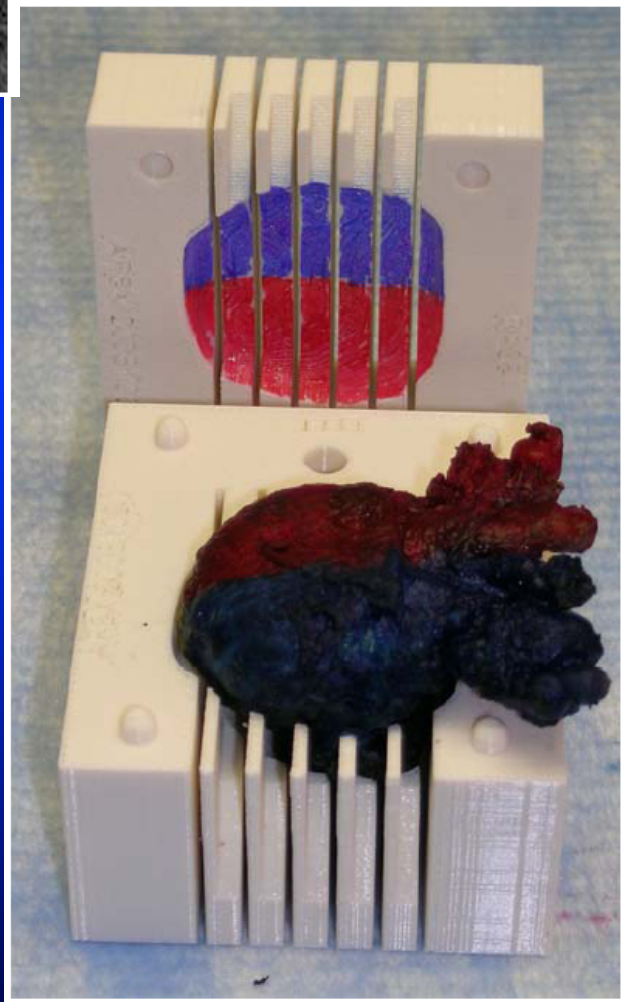

MeshLab v1.2.2 - [combine_roi_color.ply*]
File Edit Filters Render View Windows Tools Help
LOG MESSAGES
Successfully created a mesh of 10617 faces
Applied filter Poisson Reconstruction in 1546 ms
Applied filter Quadric Edge Collapse Decimation in 360 msec
<Poisson mesh>
Vertices: 4752 (24340)
Faces: 9500 (11856)
FOV: Ortho
FPS: 64.9

Prostate Mold



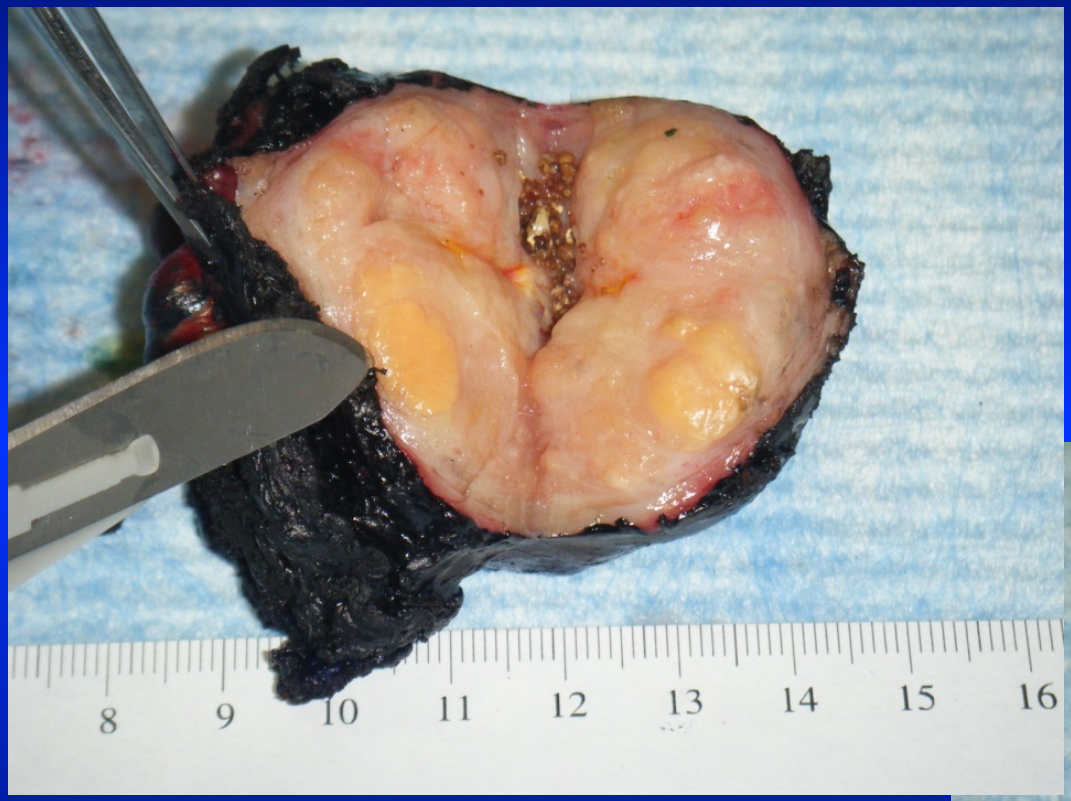


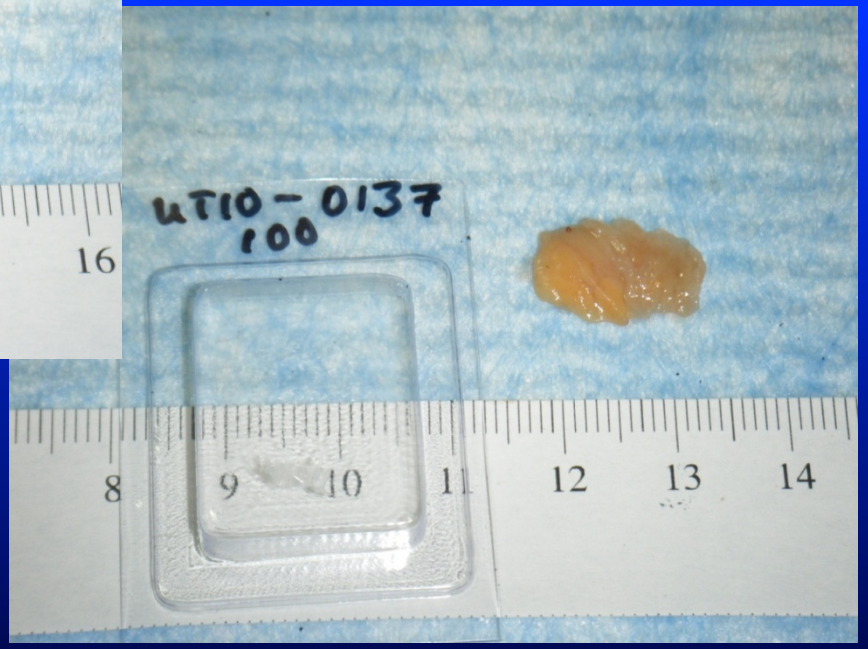




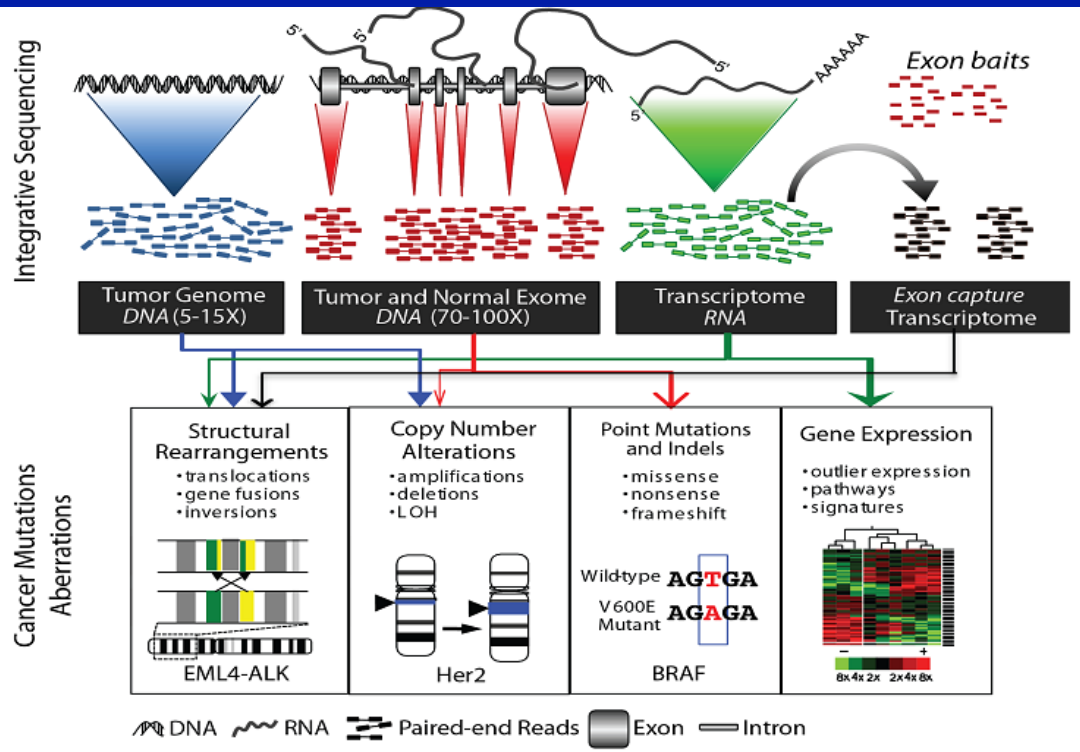
Shah V, et al. Rev Sci Instrum. 2009;80:104301.

Fresh Tissue Procurement





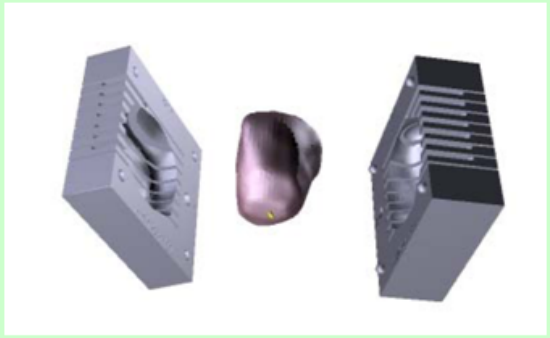
Univ of Mich Tumor Sequencing

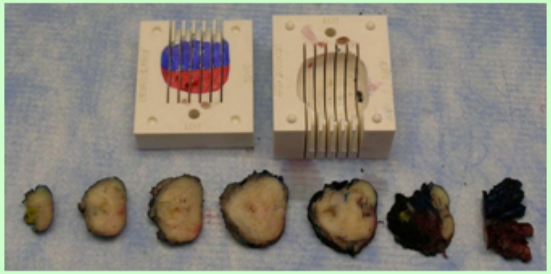


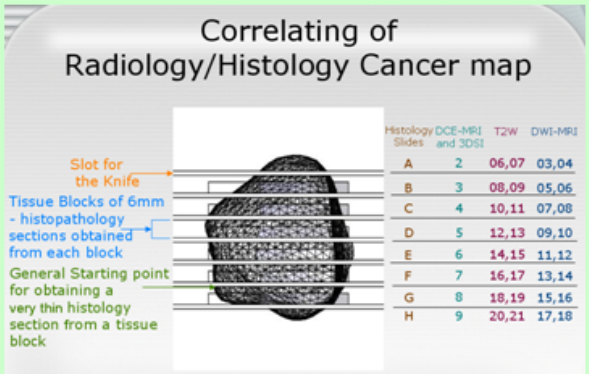
Integrative Sequencing Strategy. Illustrates integration of whole genome sequencing (blue)(carried out as needed), exome capture sequencing for 1-2% of the genome (red), transcriptome or messenger RNA sequencing (green), and exome-capture transcriptome sequencing(black)

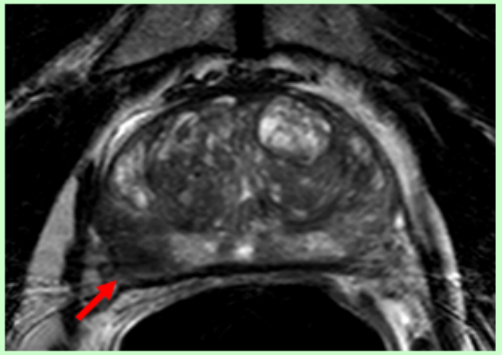
Arul Chinnaiyan, M.D., Ph.D.

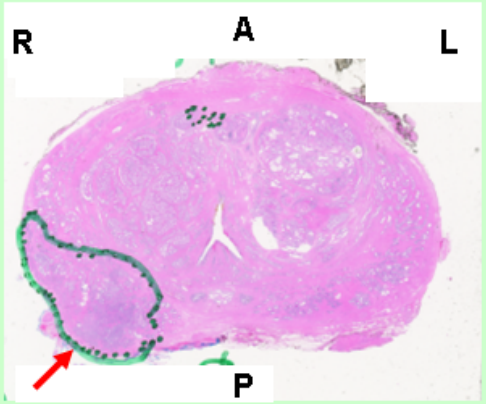
Prostate Cancer Localization with 3T erMRI: Correlation with Whole-Mount Histopathological Specimens







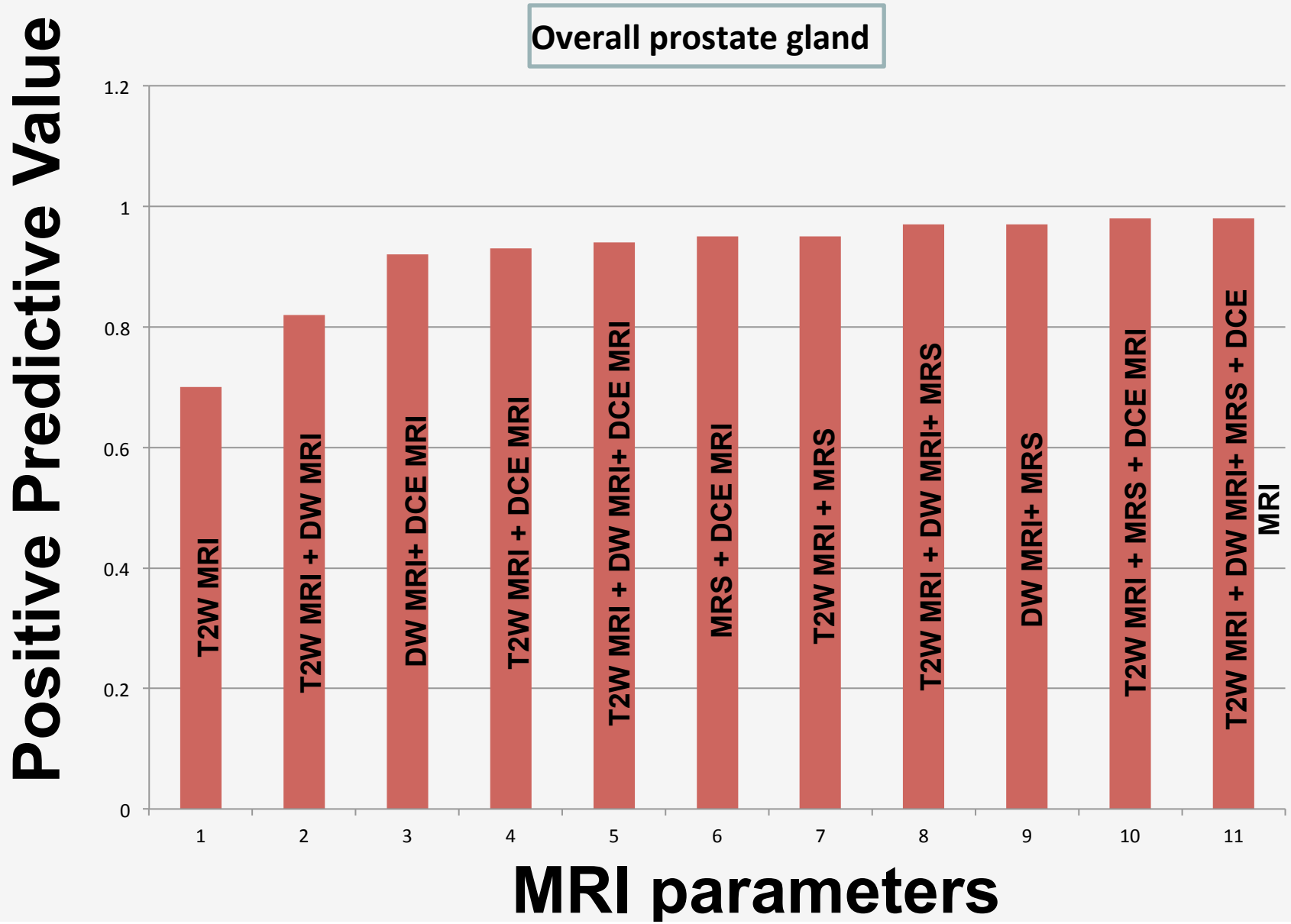




0022-5347/11/1865-1818/0
THE JOURNAL OF UROLOGY®

Vol. 186, 1818-1824, November 2011
Printed in U.S.A.
DOI:10.1016/j.juro.2011.07.013

Tumor Detection by MRI



0022-5347/11/1865-1818/0
THE JOURNAL OF UROLOGY®

Vol. 186, 1818-1824, November 2011
Printed in U.S.A.
DOI:10.1016/j.juro.2011.07.013

Negative Predictive Value

Table 2. *Positive and negative predictive values for each MRI sequence in different prostate zones*

	PZ	CG	A&CG	Overall Gland
% NPV (p value):				
T2W	0.89 (0.02)	0.92 (0.02)	0.93 (0.01)	0.9 (0.01)
ADC	0.87 (0.02)	0.92 (0.02)	0.94 (0.01)	0.89 (0.01)
MRS	0.8 (0.02)	0.91 (0.02)	0.91 (0.01)	0.83 (0.01)
DCE	0.84 (0.02)	0.92 (0.02)	0.92 (0.01)	0.87 (0.01)

PPVs were significantly different among the 4 MRI sequences ($p < 0.01$) whereas NPVs were similar.

To Improve current methods of detection / treatment of PCa:

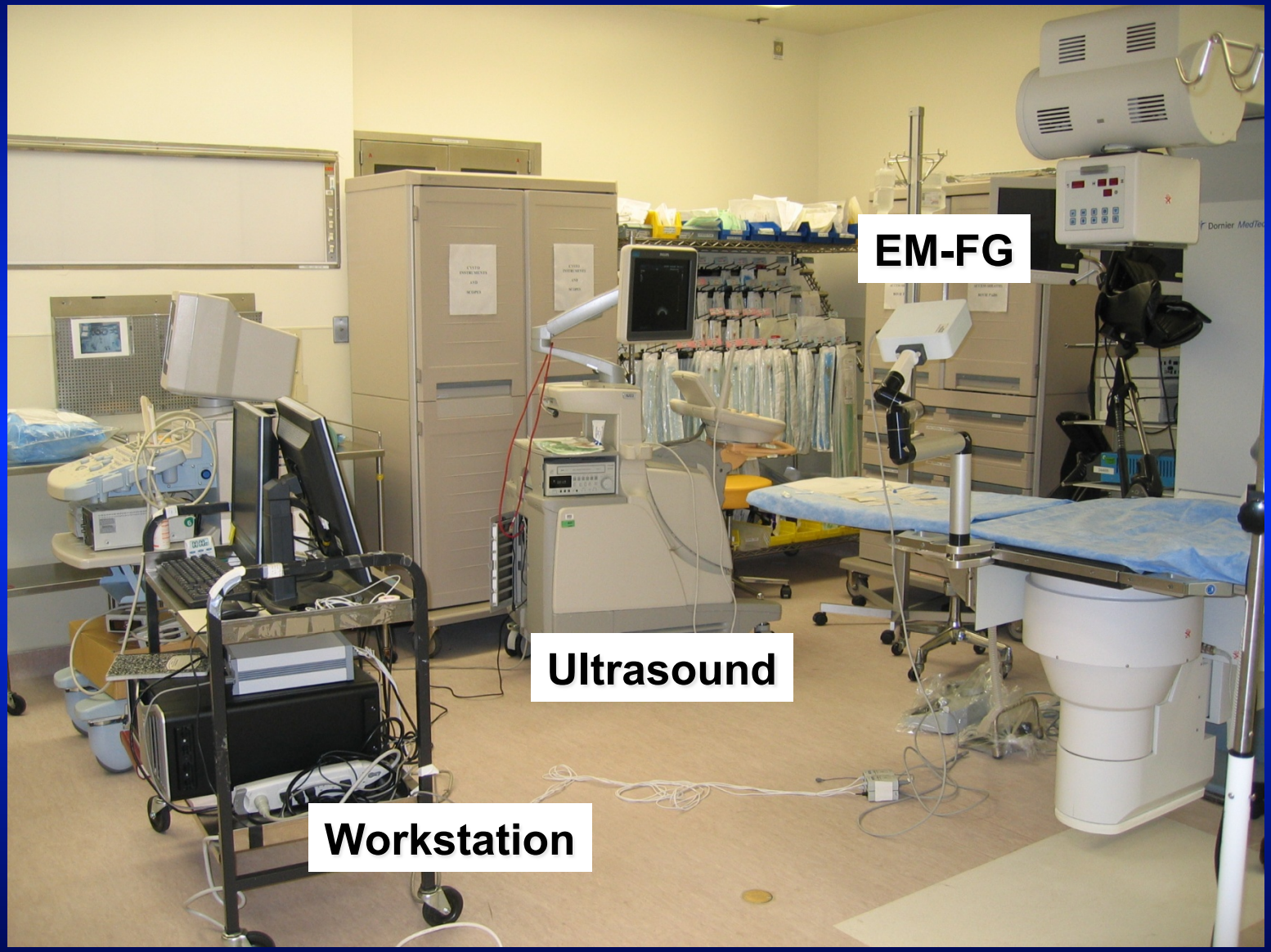
- Diagnostic imaging
  - Improve MR Imaging sequences
- Devices
  - If we have imaging that can see the tumor in the prostate, can we “hit” it (biopsy device)

Image fusion guided prostate bx

- Work here at NIH leads the way in developing this technology with the help of interdisciplinary collaborative efforts
  - Interventional Radiology, Diagnostic Radiology, Pathology, Engineering, Medical Oncology, CIT, Industry (CRADA Philips)

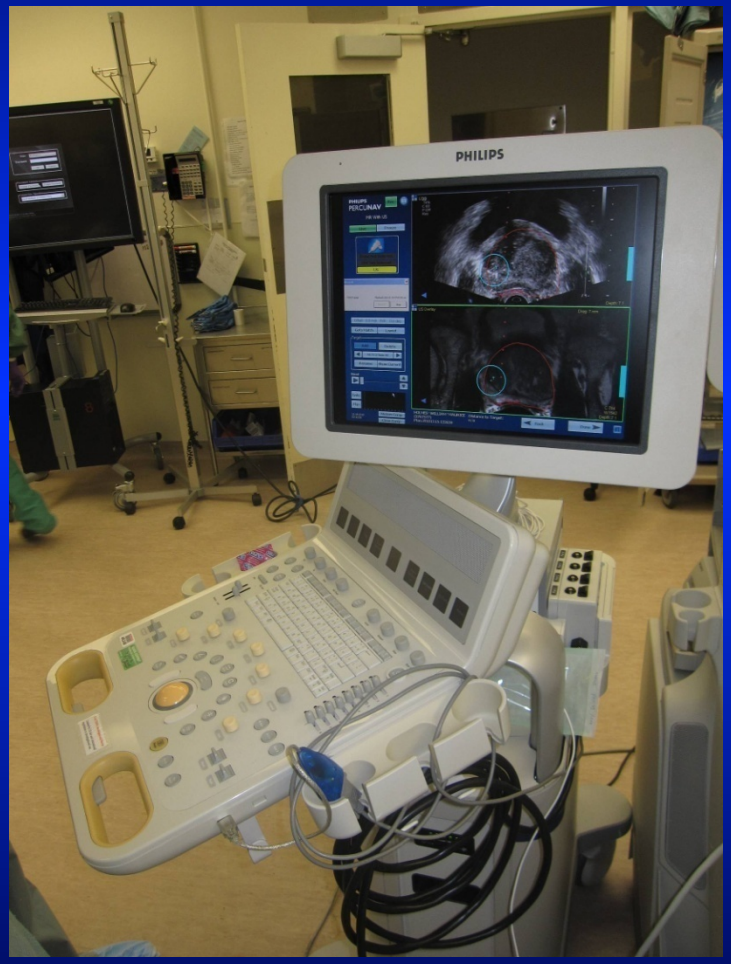
CRADA NIH-Philips medical

Image Fusion Guided Platform (2007)



CRADA NIH-Philips medical

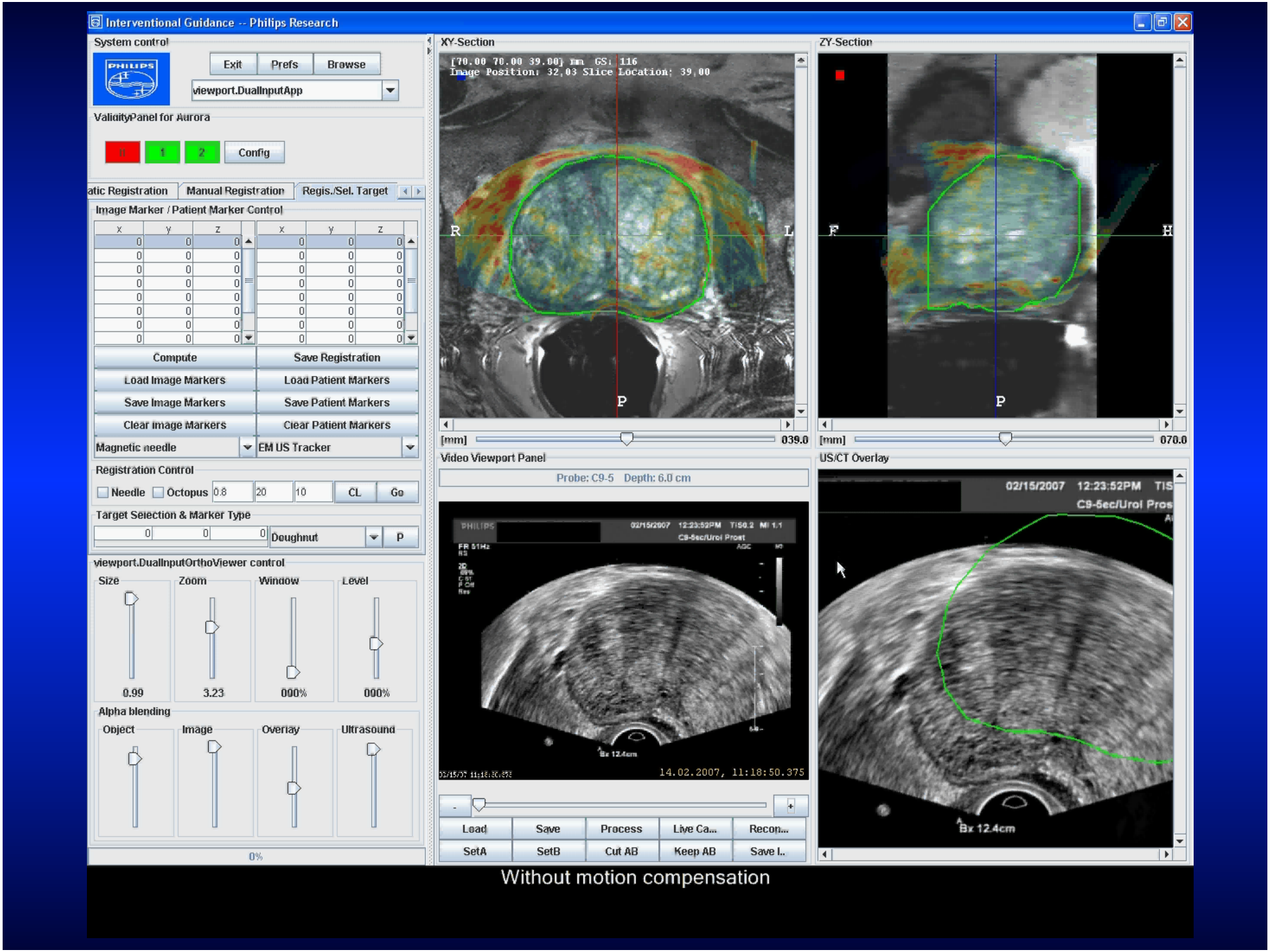
Current Platform

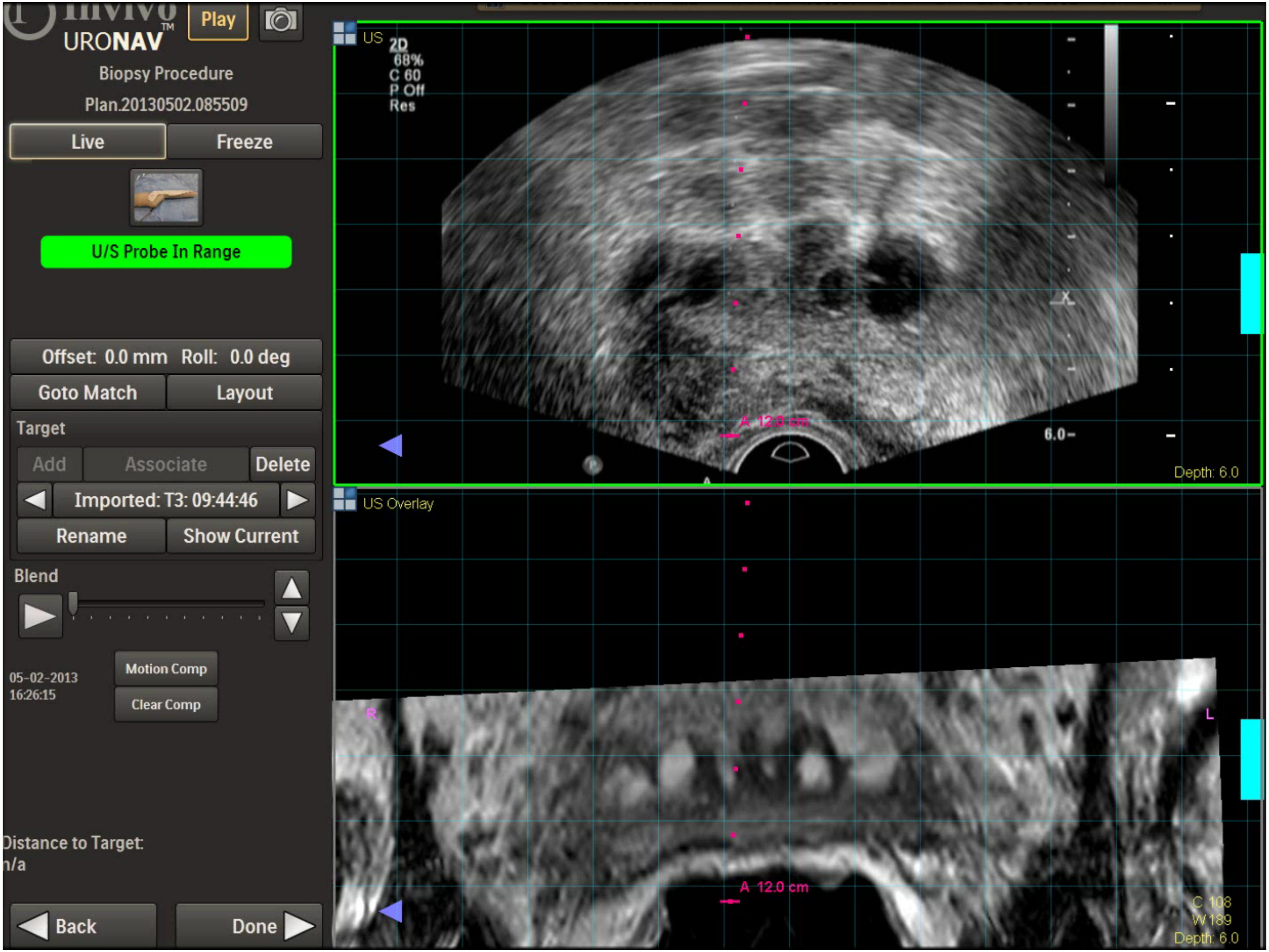


CRADA NIH-Philips medical

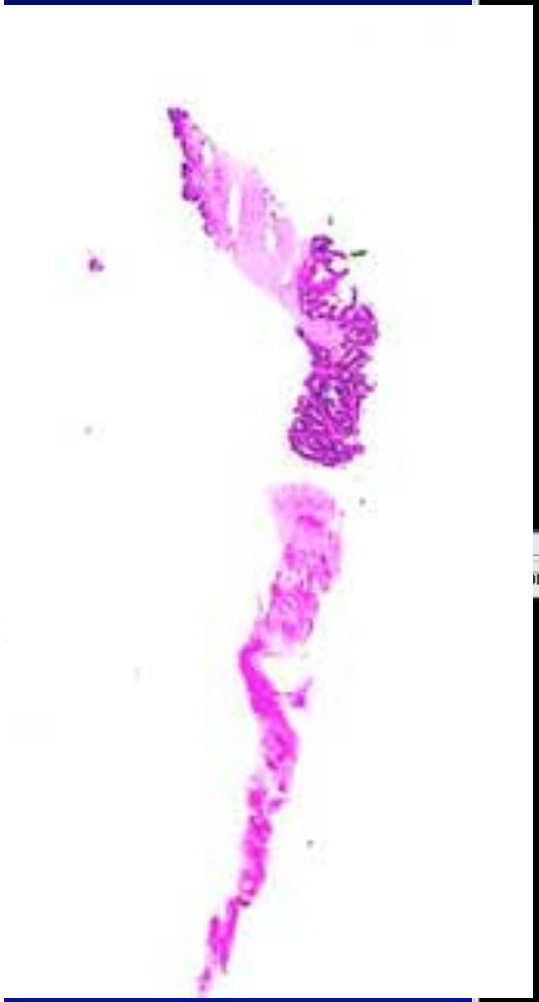
Electromagnetic Spatial Tracking System

MR-US prostate image fusion

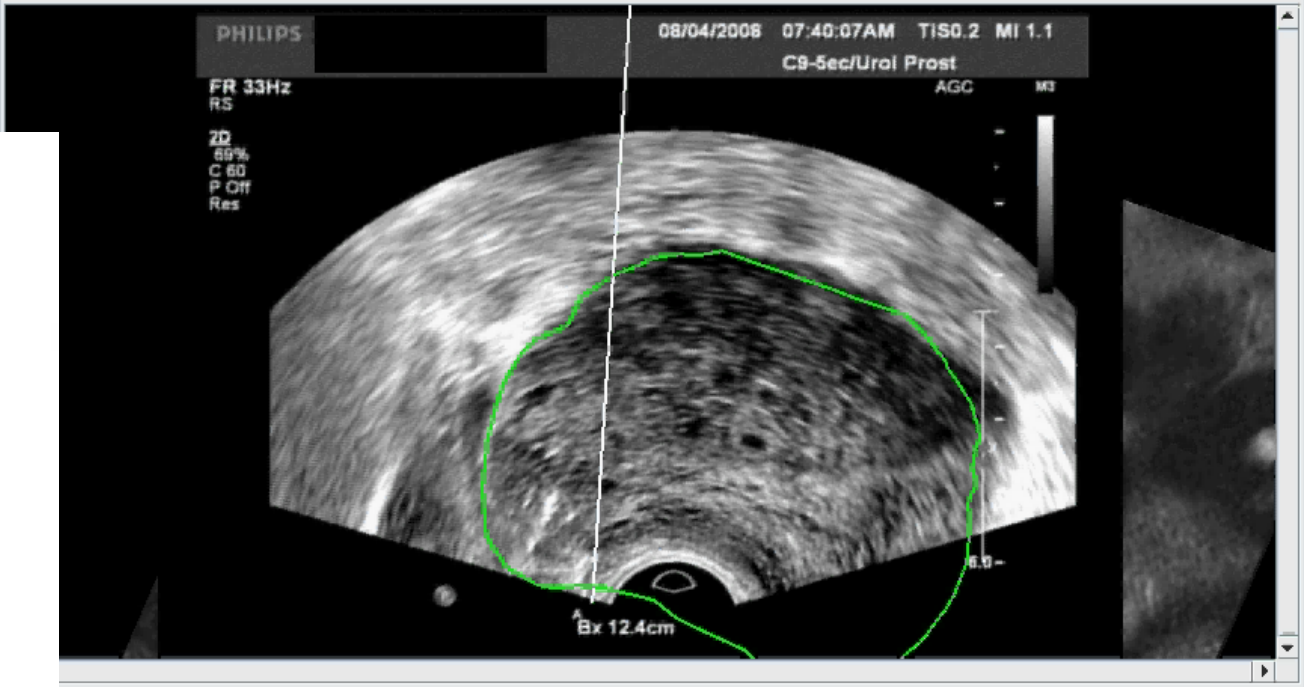

Interventional Guidance -- Philips Research
System control
Exit
Prefs
Browse
viewport.DualInputApp
ValidityPanel for Aurora
Config
Manual Registration
Regis./Sel. Target
Image Marker / Patient Marker Control
Compute
Save Registration
Load Image Markers
Load Patient Markers
Save Image Markers
Save Patient Markers
Clear Image Markers
Clear Patient Markers
Magnetic needle
EM US Tracker
Registration Control
Needle
Octopus
CL
Go
Target Selection & Marker Type
Doughnut
P
viewport.DualInputOrthoViewer control
Size
Zoom
Window
Level
0.99
3.23
000%
000%
Alpha blending
Object
Image
Overlay
Ultrasound
0%
XY-Section
[70.00 70.00 39.00] mm GS: 116
Image Position: 32,03 Slice Location: 39,00
R
L
P
[mm]
039.0
ZY-Section
F
H
P
[mm]
070.0
Video Viewport Panel
Probe: C9-5 Depth: 6.0 cm
14.02.2007, 11:18:50.375
Load
Save
Process
Live Ca...
Recon...
SetA
SetB
Cut AB
Keep AB
Save I..
US/CT Overlay
02/15/2007 12:23:52PM
Bx 12.4cm
Without motion compensation



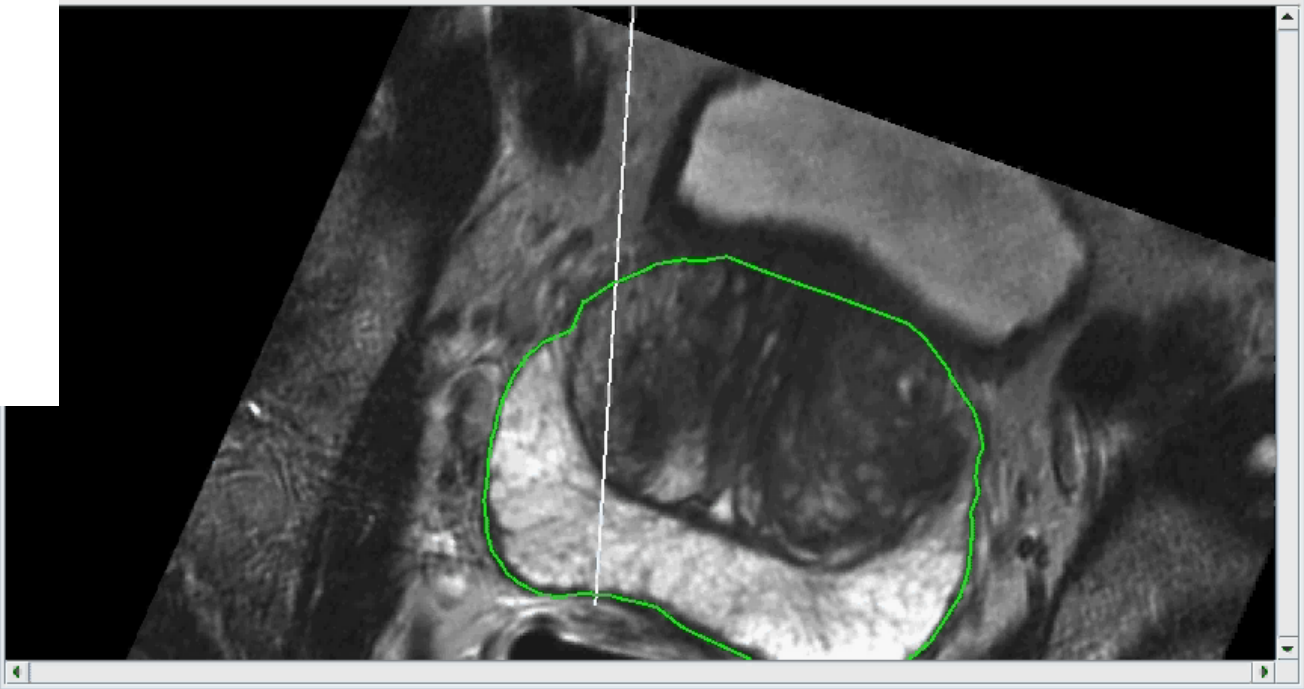
UroNAV
Play
Biopsy Procedure
Plan.20130502.085509
Live
Freeze
U/S Probe In Range
Offset: 0.0 mm Roll: 0.0 deg
Goto Match
Layout
Target
Add
Associate
Delete
Imported: T3: 09:44:46
Rename
Show Current
Blend
05-02-2013
16:26:15
Motion Comp
Clear Comp
Distance to Target:
n/a
Back
Done
US
2D
68%
C 60
P Off
Res
A 12.0 cm
6.0
Depth: 6.0
US Overlay
R
L
A 12.0 cm
C 108
W 189
Depth: 6.0



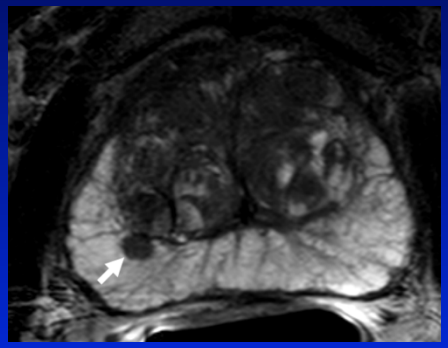
US/CT Overlay

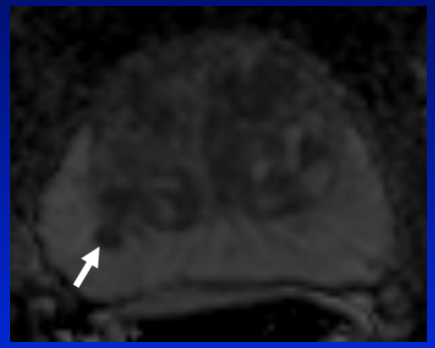


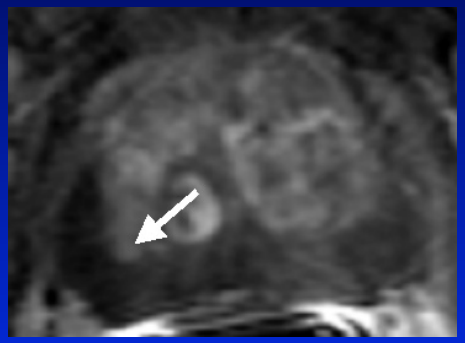
n XY

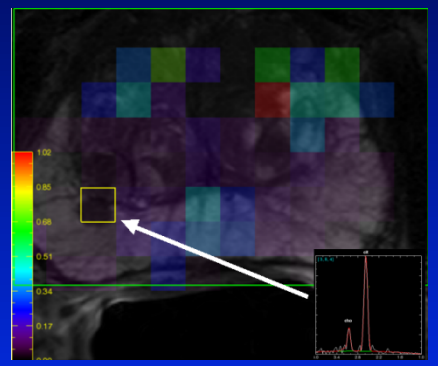


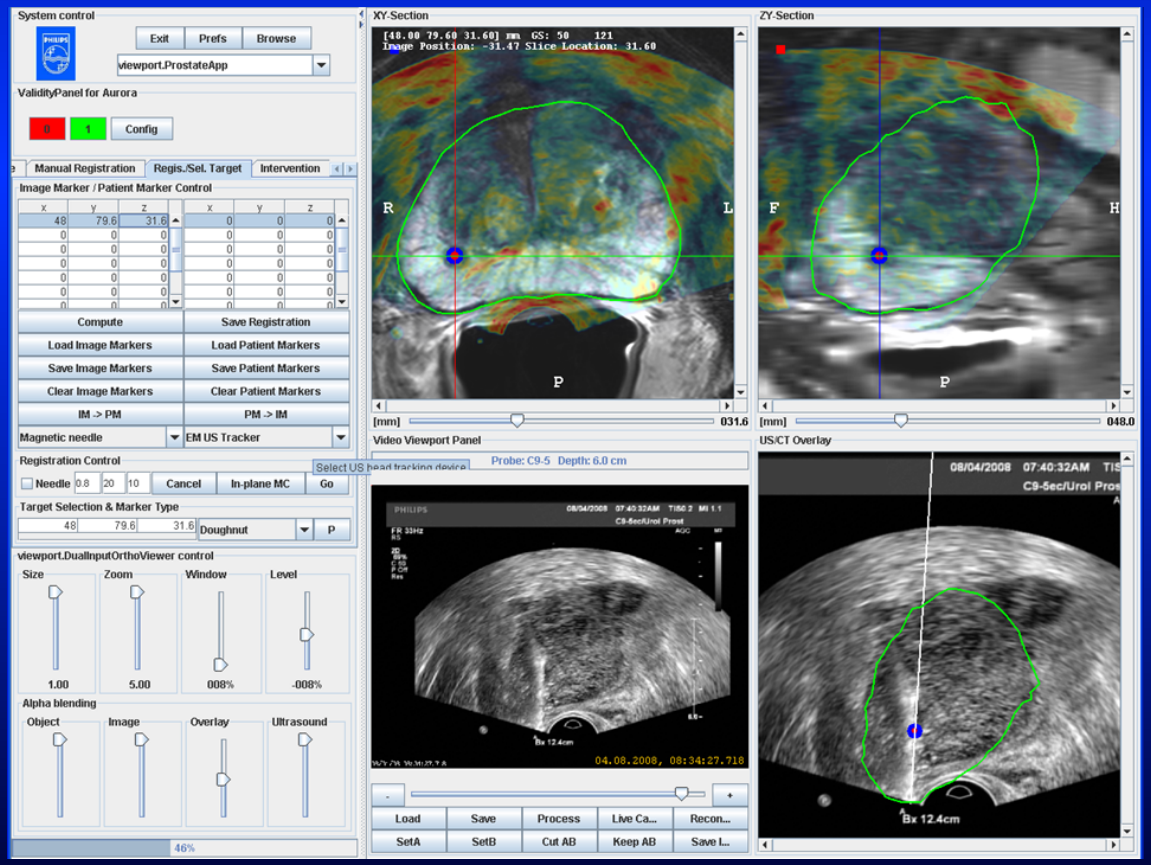
59 yo, PSA=6 ng/mL, with prior negative TRUS biopsy











Gleason 3+4 (70%)

0022-5347/11/1864-1281/0
THE JOURNAL OF UROLOGY®

Vol. 186, 1281-1285, October 2011
Printed in U.S.A.
DOI:10.1016/j.juro.2011.05.078

Magnetic Resonance Imaging/Ultrasound Fusion Guided Prostate Biopsy Improves Cancer Detection Following Transrectal Ultrasound Biopsy and Correlates With Multiparametric Magnetic Resonance Imaging

Peter A. Pinto,*,†,‡ Paul H. Chung,†,§ Ardeshir R. Rastinehad,§ Angelo A. Baccala, Jr.,§ Jochen Kruecker,‖ Compton J. Benjamin,§ Sheng Xu,‖ Pingkun Yan,‖ Samuel Kadoury,‖ Celene Chua,§ Julia K. Locklin,§ Baris Turkbey,§ Joanna H. Shih,§ Stacey P. Gates,§ Carey Buckner,§ Gennady Bratslavsky,§ W. Marston Linehan,§ Neil D. Glossop,‖ Peter L. Choyke¶ and Bradford J. Wood‡

From the Urologic Oncology Branch (PAP, PHC, ARR, AAB, CJB, CC, GB, WML) and Molecular Imaging Program (BT, PLC), Center for Cancer Research, and Center for Interventional Oncology, Department of Radiology and Imaging Sciences (JKL, SPG, CB, BJW), Clinical Center & National Cancer Institute, National Institutes of Health, Bethesda, and Biometric Research Branch, Division of Cancer Treatment and Diagnosis, National Cancer Institute, National Institutes of Health, Rockville, Maryland, Philips Healthcare, Toronto, Canada (NDG), and Philips Research North America, Briarcliff Manor, New York (JK, SX, PY, SK, JHS)

0022-5347/11/1864-1281/0
THE JOURNAL OF UROLOGY®

Vol. 186, 1281-1285, October 2011
Printed in U.S.A.
DOI:10.1016/j.juro.2011.05.078

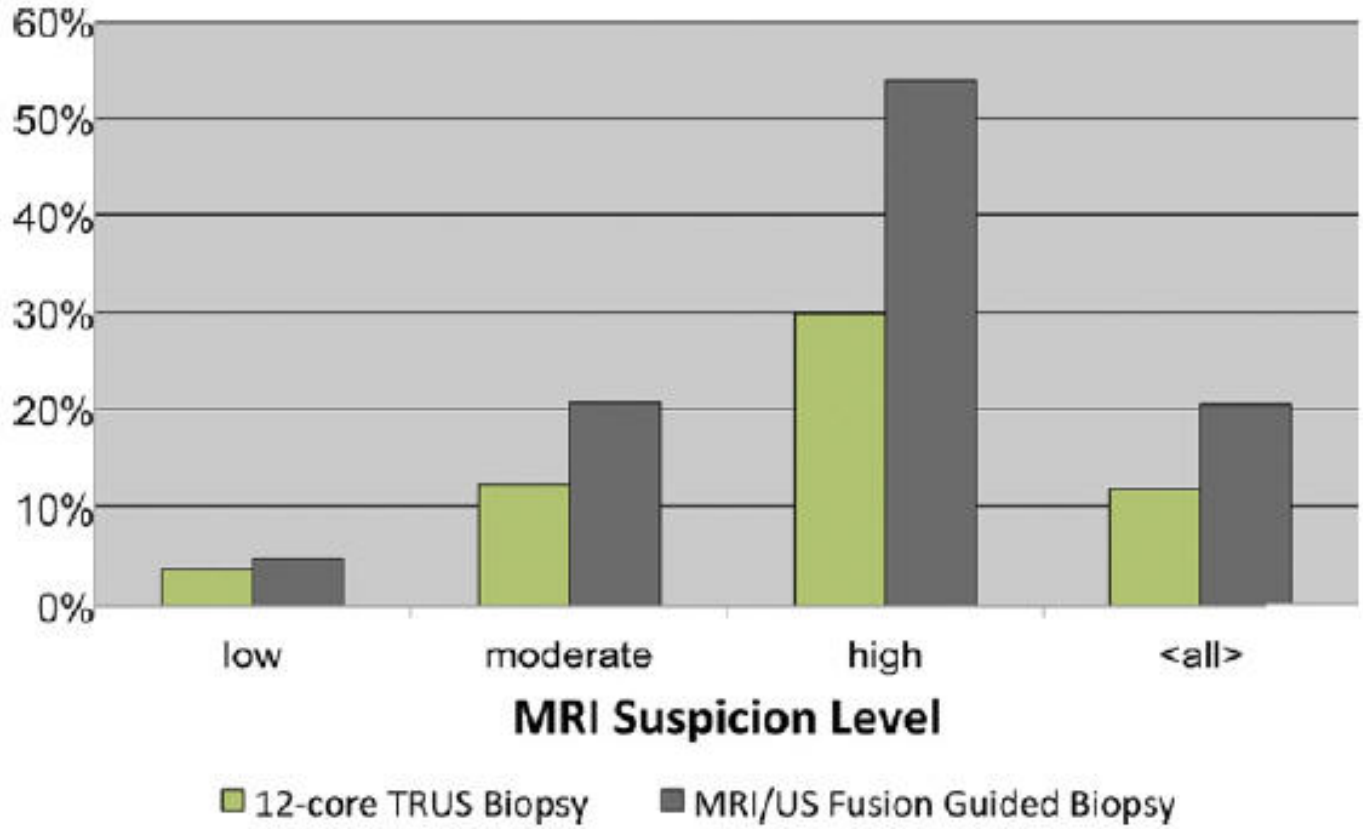


Figure 2. Cancer detection rates for biopsy cores were compared between standard 12-core TRUS biopsy alone and MRI/US fusion guided biopsy alone.

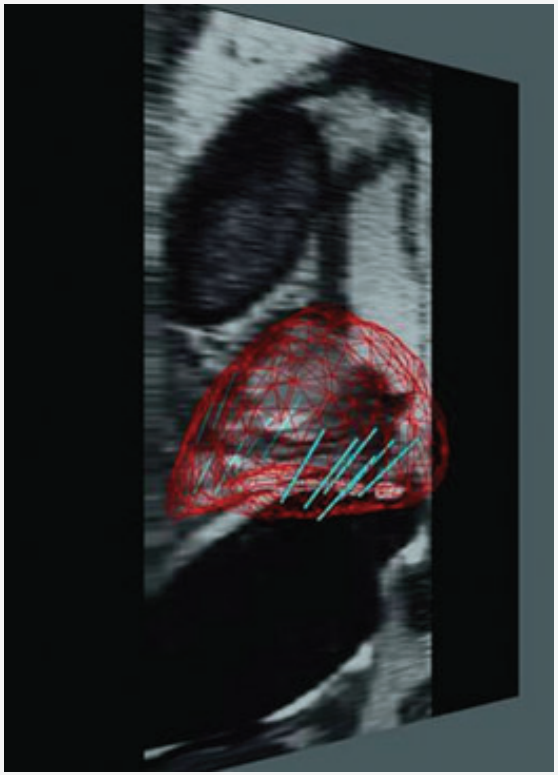
BJUI
BJU INTERNATIONAL

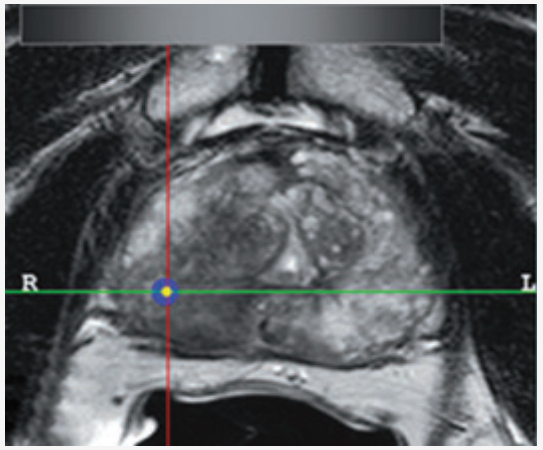
Documenting the location of prostate biopsies with image fusion

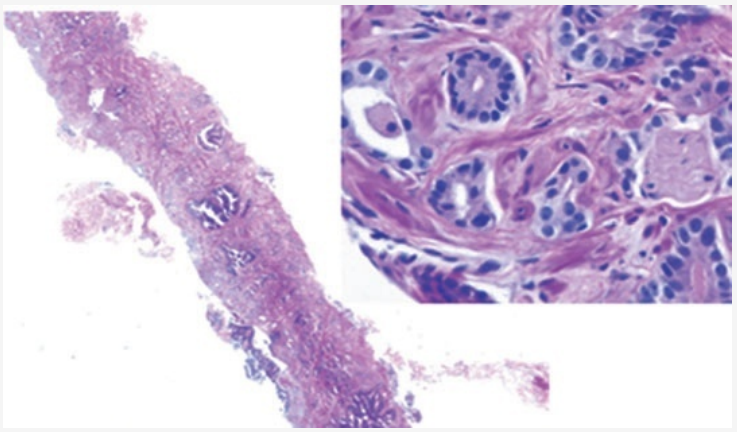
Baris Turkbey*, Sheng Xu†, Jochen Kruecker†, Julia Locklin‡, Yuxi Pang§, Marcelino Bernardo*,¶, Maria J. Merino††, Bradford J. Wood‡, Peter L. Choyke* and Peter A. Pinto‡‡

*Molecular Imaging Program, ††Laboratory of Pathology, and ‡‡Urologic Oncology Branch, NCI, NIH, ‡Center for Interventional Oncology, NCI and Radiology and Imaging Sciences, Clinical Center, NIH, Bethesda, MD, †Philips Research North America, Briarcliff Manor, NY, §Philips Healthcare, Cleveland, OH, and ¶SAIC-Frederick, NCI-Frederick, Frederick, MD, USA

BJU Int. 2011 Jan;107(1):53-7.







NATIONAL CANCER INSTITUTE

0022-5347/12/1886-2152/0
THE JOURNAL OF UROLOGY®

http://dx.doi.org/10.1016/j.juro.2012.08.025
Vol. 188, 2152-2157, December 2012
Printed in U.S.A.

Multiparametric Magnetic Resonance Imaging and Ultrasound Fusion Biopsy Detect Prostate Cancer in Patients with Prior Negative Transrectal Ultrasound Biopsies

Srinivas Vourganti,*,† Ardeshir Rastinehad,†,‡ Nitin K. Yerram,* Jeffrey Nix,* Dmitry Volkin,* An Hoang,* Baris Turkbey,* Gopal N. Gupta,* Jochen Kruecker,‡ W. Marston Linehan,* Peter L. Choyke,* Bradford J. Wood§ and Peter A. Pinto*,‖

From the Urologic Oncology Branch (SV, AR, NKY, JN, DV, AH, GNG, WML, PAP) and Molecular Imaging Program (BT, PLC), National Cancer Institute, and Center for Interventional Oncology, Department of Radiology and Imaging Sciences (BJW, PAP), National Institutes of Health, Bethesda, Maryland, and Philips Research North America, Briarcliff Manor, New York (JK)

0022-5347/12/1886-2152/0
THE JOURNAL OF UROLOGY®

http://dx.doi.org/10.1016/j.juro.2012.08.025
Vol. 188, 2152-2157, December 2012
Printed in U.S.A.

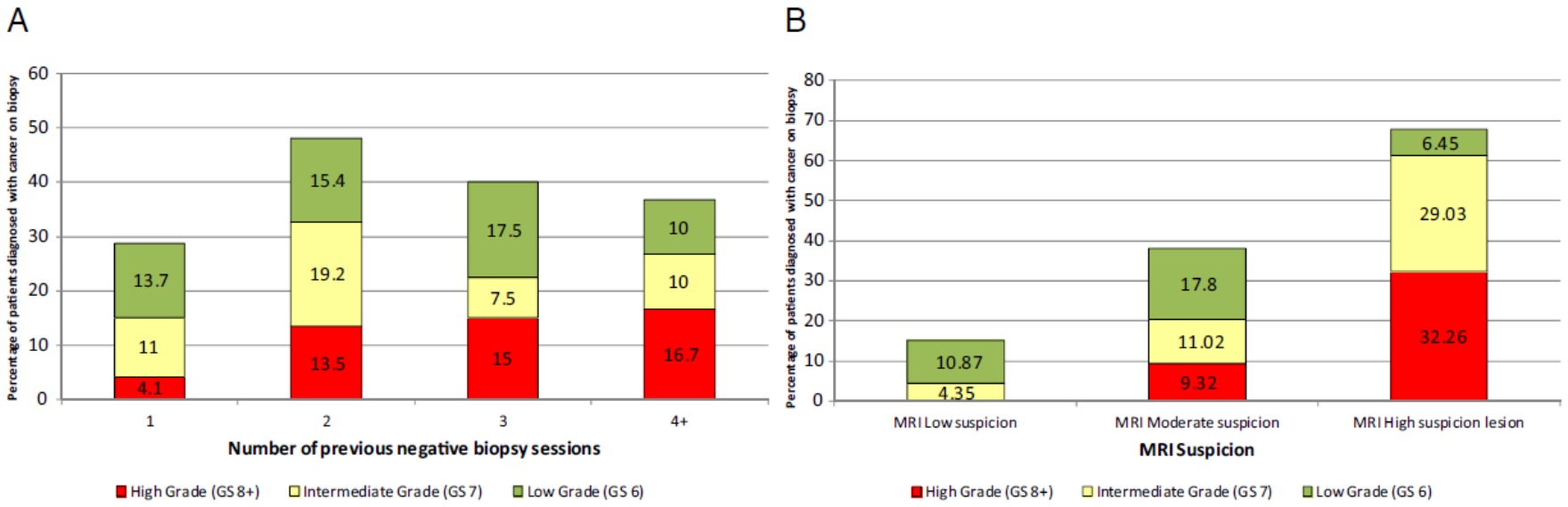


Figure 1. Diagnostic yield stratified by number of previous negative biopsies (*A*) and by MRI suspicion level (*B*). Diagnostic yield is further broken down into Gleason grade (low grade GS 6, intermediate grade GS 7 and high grade GS 8–10).

0022-5347/12/1886-2152/0
THE JOURNAL OF UROLOGY®

http://dx.doi.org/10.1016/j.juro.2012.08.025
Vol. 188, 2152-2157, December 2012
Printed in U.S.A.

Table 2. Biopsy results stratified by standard TRUS vs targeted MRI/US fusion platform

	All cancers	Low Grade (GS 6)	Intermediate Grade (GS 7)	High Grade (GS 8+)
Either modality detected	73	28	24	21
MRI targeting detected	56 (76.7%)	16 (57.1%)	19 (79.2%)	21 (100%)
US guided detected	45 (61.6%)	23 (82.1%)	12 (50%)	10 (47.6%)
Both modalities detected	28	11	7	10
MRI targeting upgraded risk	28 (38.4%)	5 (17.9%)	12 (50%)	11 (52.3%)

Other Applications for Physicians

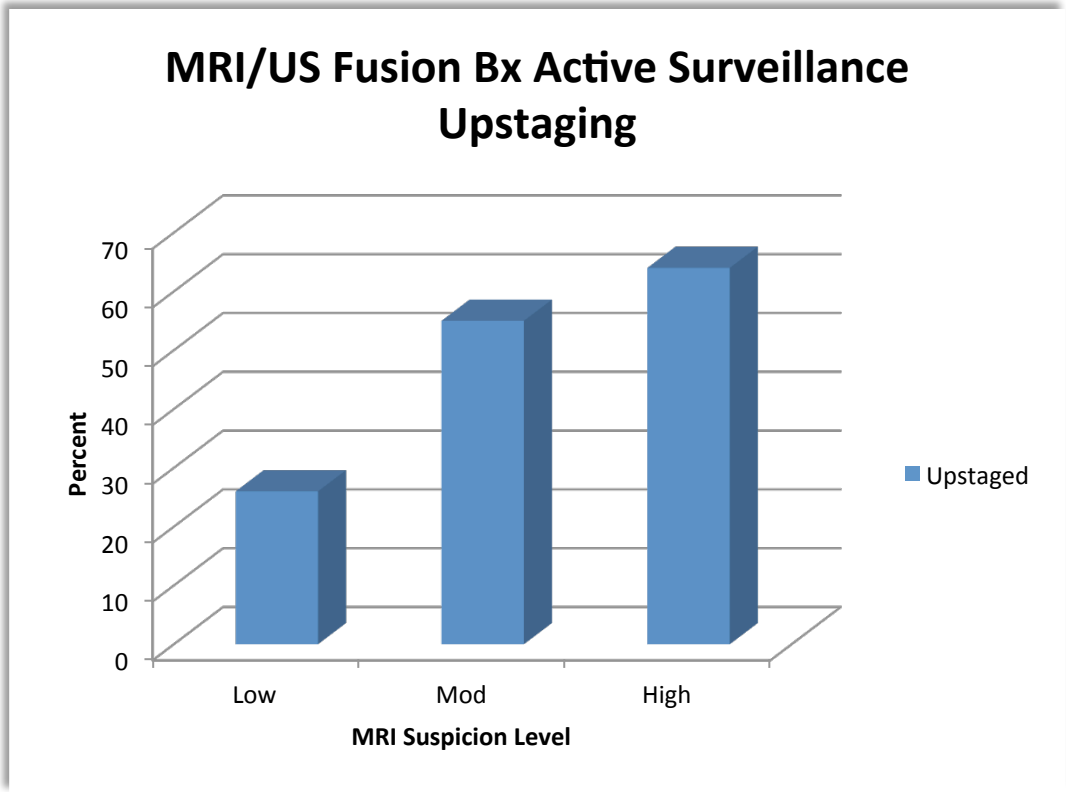
- Active Surveillance

Active Surveillance

- Established treatment option for low grade low volume prostate cancer
- Can MRI help ?
  - Detect higher grade or volume tumors
  - Allow ***patients*** to feel more comfortable with AS
  - Allow ***physicians*** to feel more comfortable with AS

NCI Protocol:
Prostate MRI / Bx and Active Surveillance

Pt. Demographics	
N	74
Mean Age	60.5
Race	
White	63
African American	11
Clinical Stage	
T1c	74
Mean PSA	4.79
Mean PSA Density	0.09
Mean MRI Volume	52



- **AS criteria: Gleason ≤ 6; PSAD ≤ 0.15; cT 1; ≤ 2 cores +; ≤ 50% any core**
- **MRI/US fusion bx was median 8 mos from initial outside biopsy**
- **41% of patients re-staged & no longer AS candidates based on grade/volume**
- **Risk of staging out of AS increases based on MRI suspicion level**

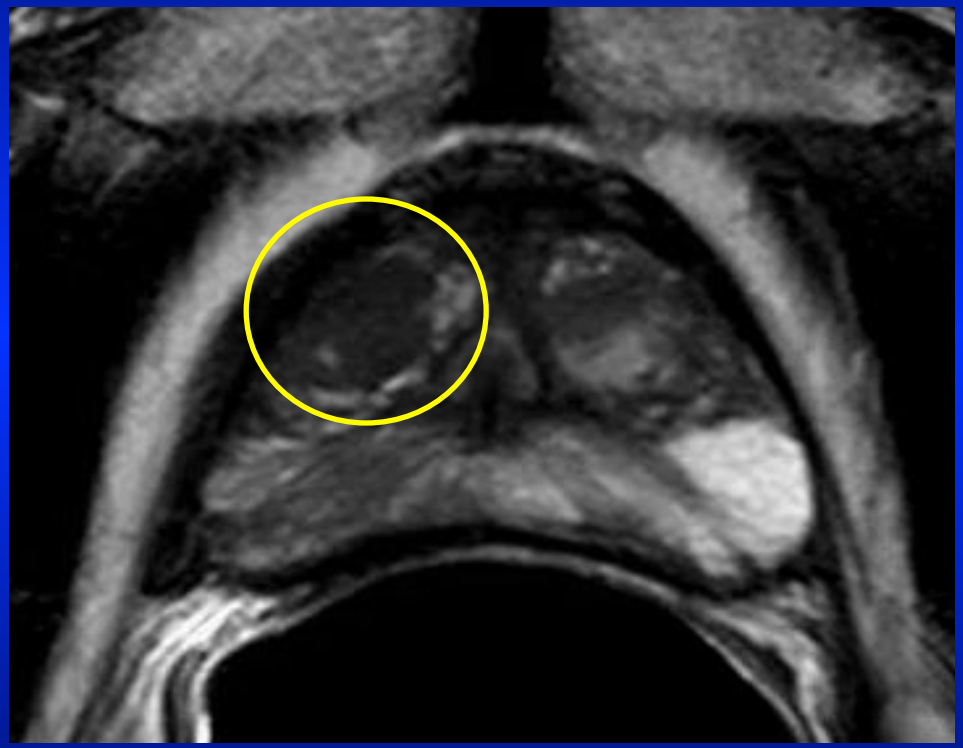
Other applications for Physicians

- **Treatment**

60 year old healthy male

- Elevated PSA led to a standard of care random 12 core prostate biopsy
- Only 5% Gleason 6 in a single core
- Low grade low volume cancer does not need to be treated, let alone even discovered

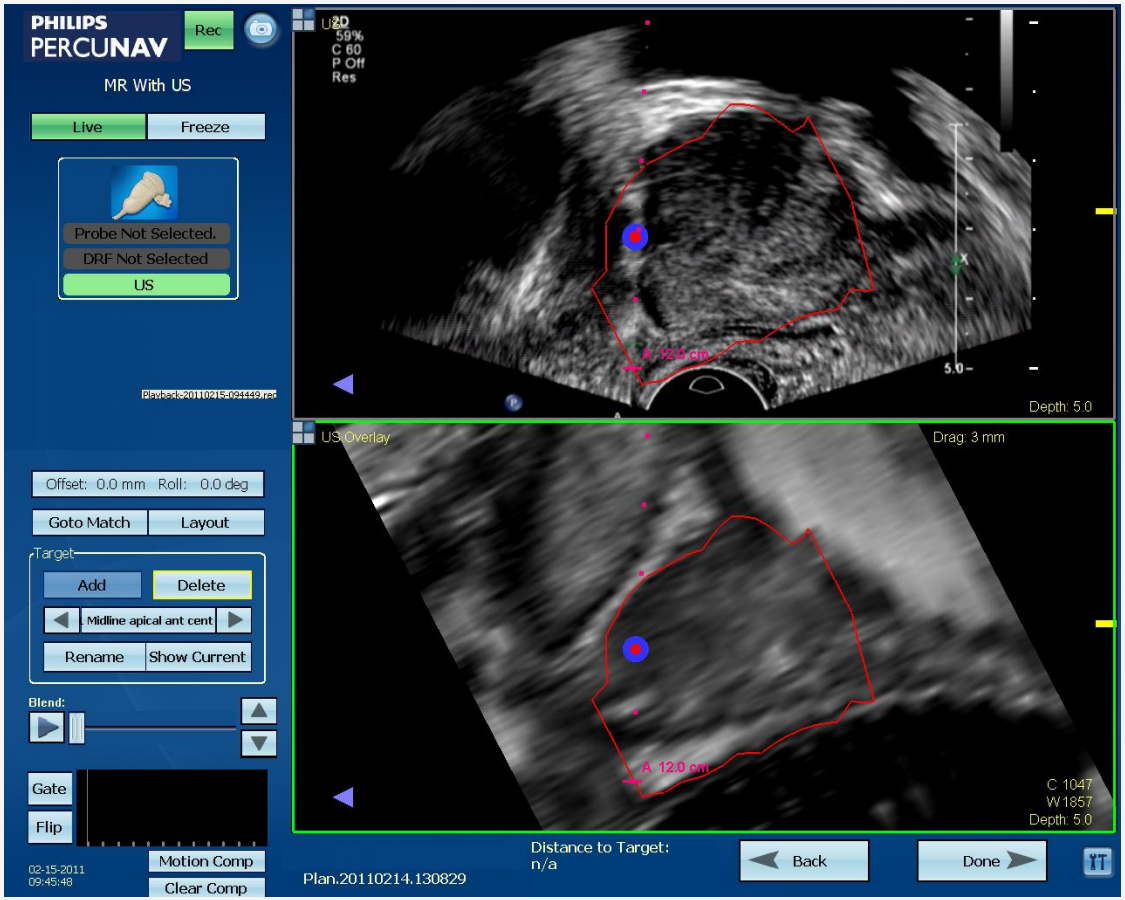
Enrolled in NCI protocol



- Image directed biopsy Gleason 8 in 100% of the cores
- Final pathology after surgical removal had Gleason 8 cancer in over 50% of the prostate
- Harms vs Benefit ?

63 years old, 4 prior negative TRUS biopsies, PSA 12.8

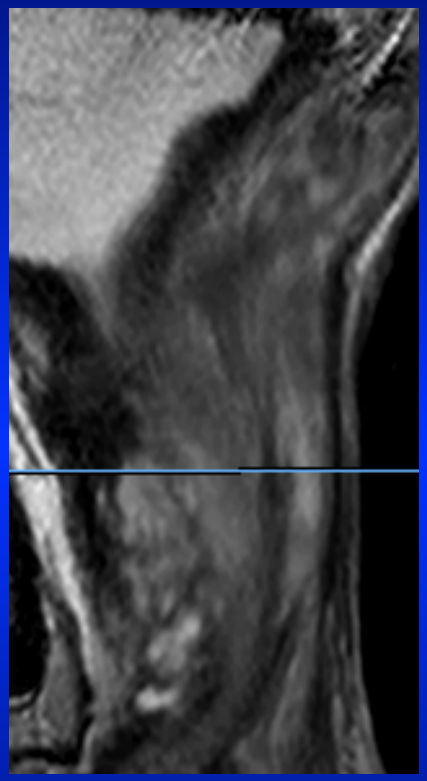
- 2 MRI lesions (apical anterior central)
- 12 core extended sextant TRUS biopsy cores all negative
- All MRI/TRUS targeted biopsies positive
- Gleason 4+4=8 (85% of cores)

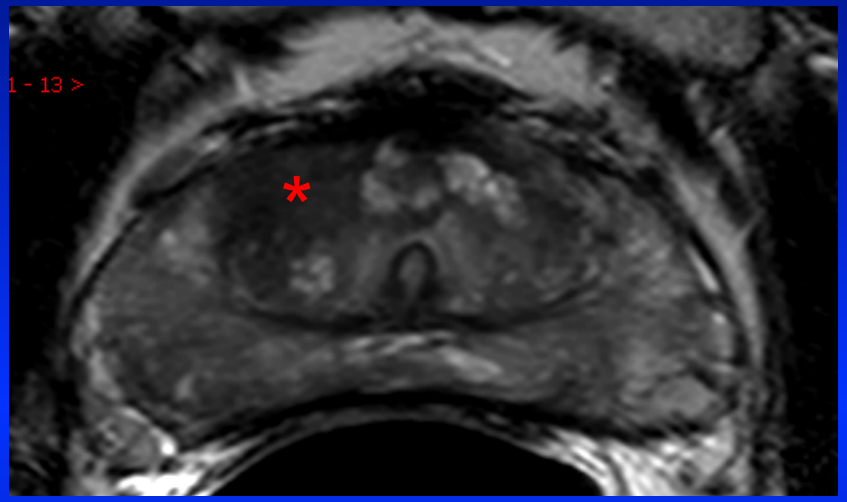


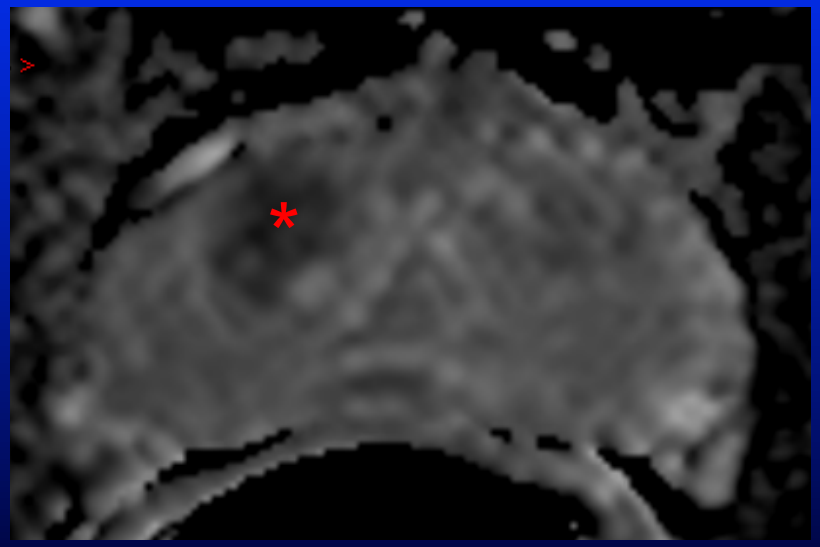
68 year old with elevated PSA

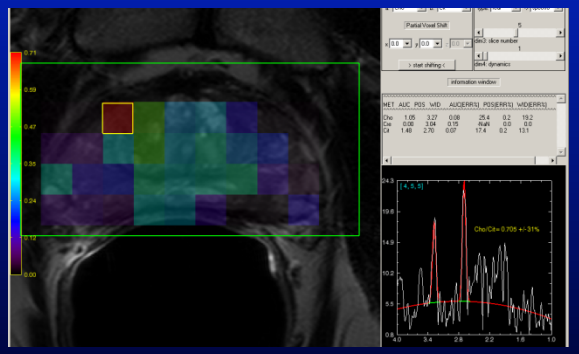
- Extended sextant 12 core TRUS biopsy is negative for cancer
- PSA continues to rise
- Each year for the next 5 years TRUS biopsies are negative
- 7^{th} year a saturation prostate biopsy under anesthesia is negative

Multiparametric Prostate MRI









Right mid anterior central gland lesion

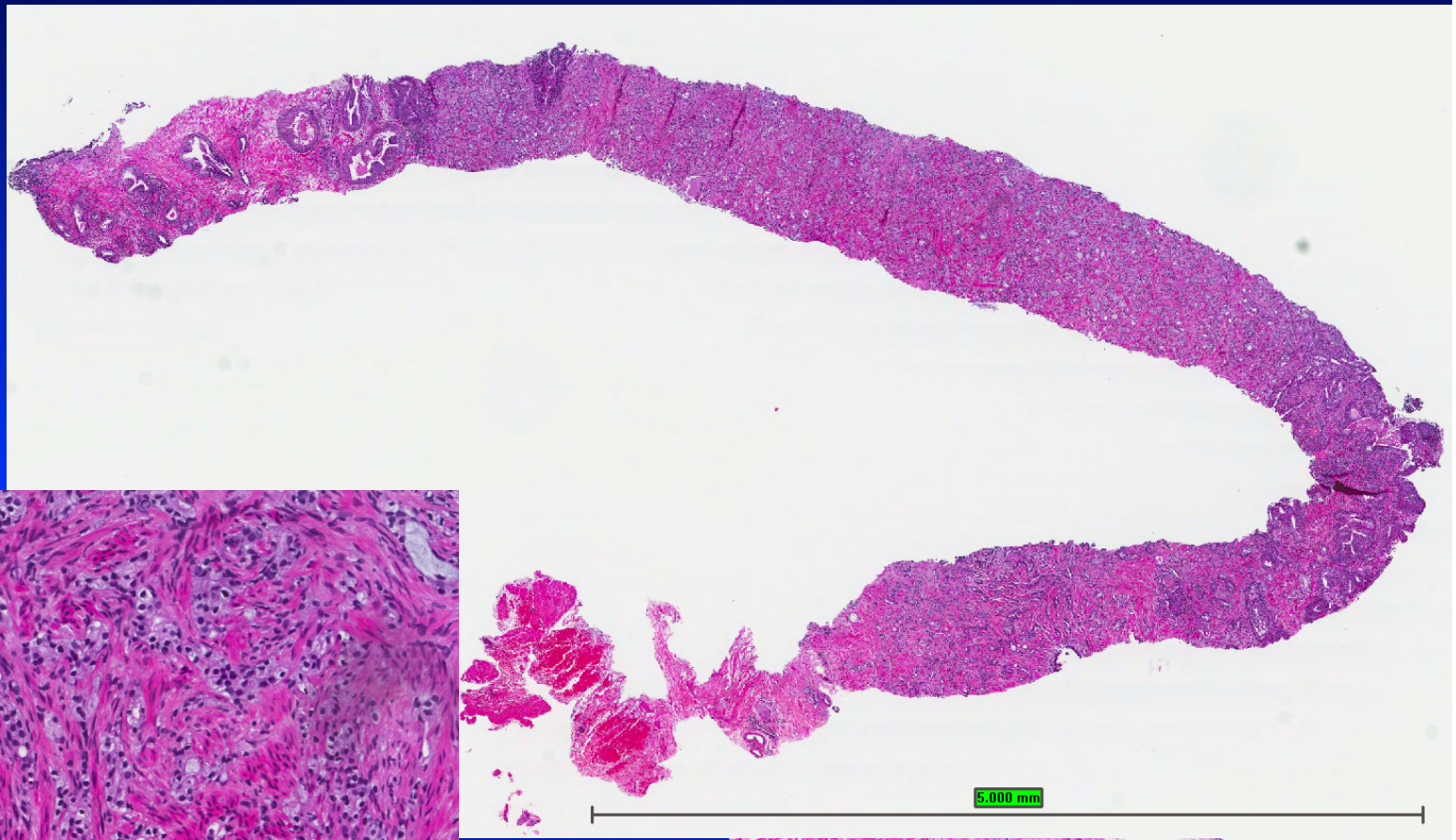
T2 +

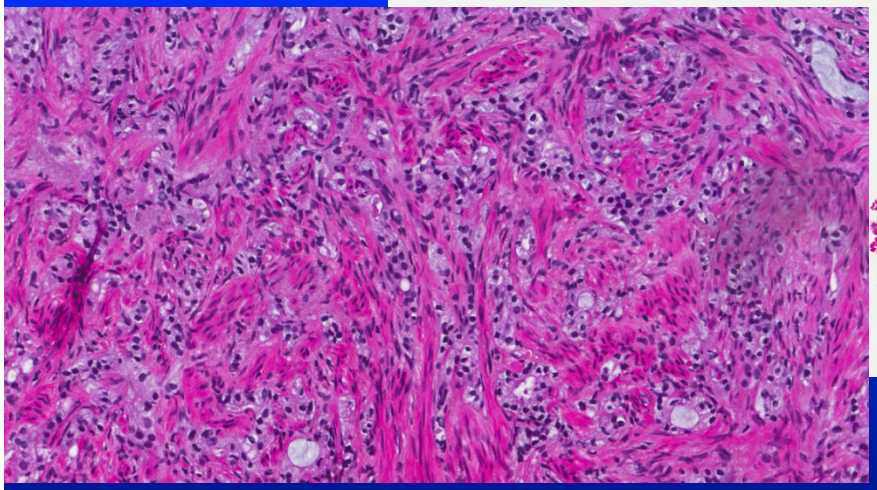
DWI +

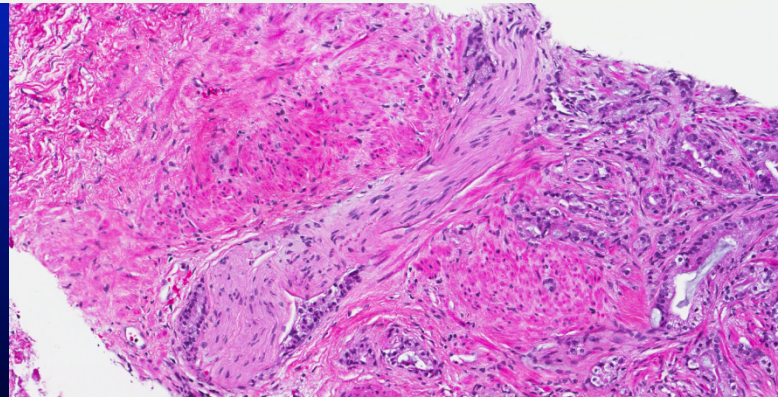
DCE +

MRS +

MRI / TRUS Guided Biopsy





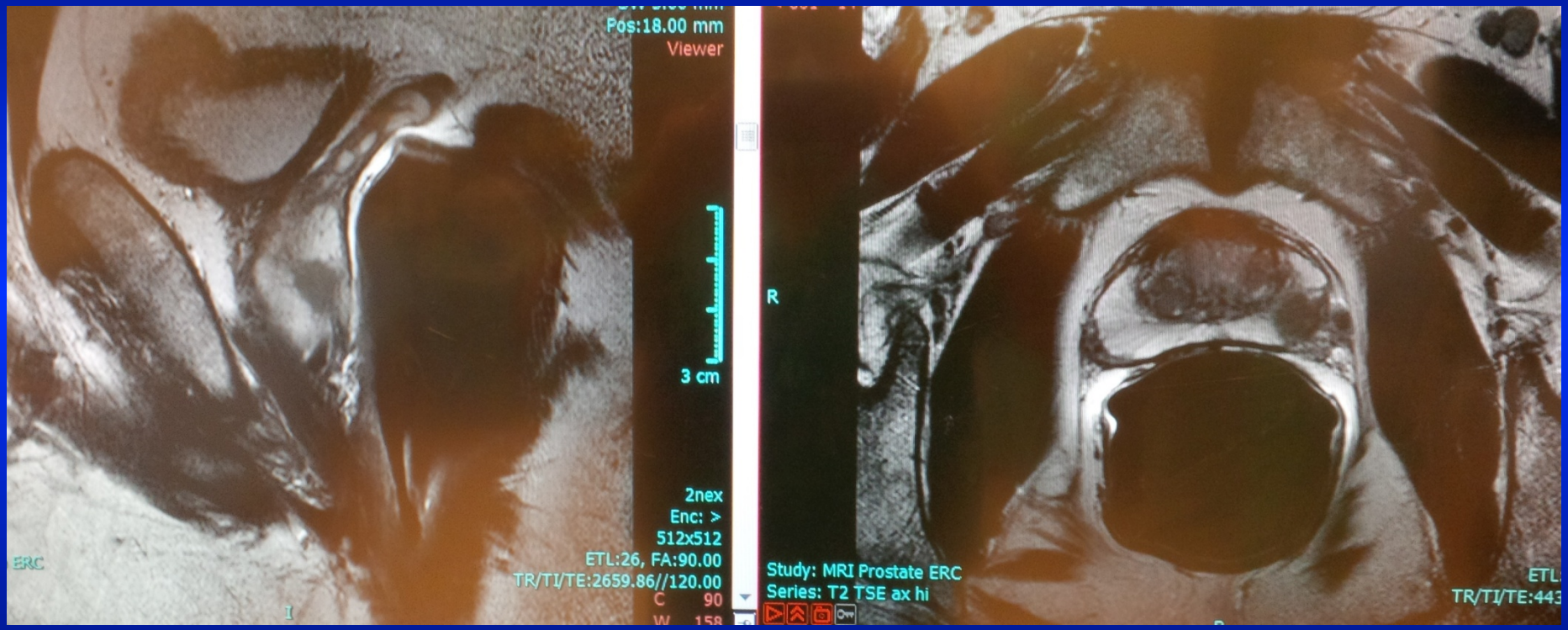


Gleason 4+5=9

57 year old healthy male

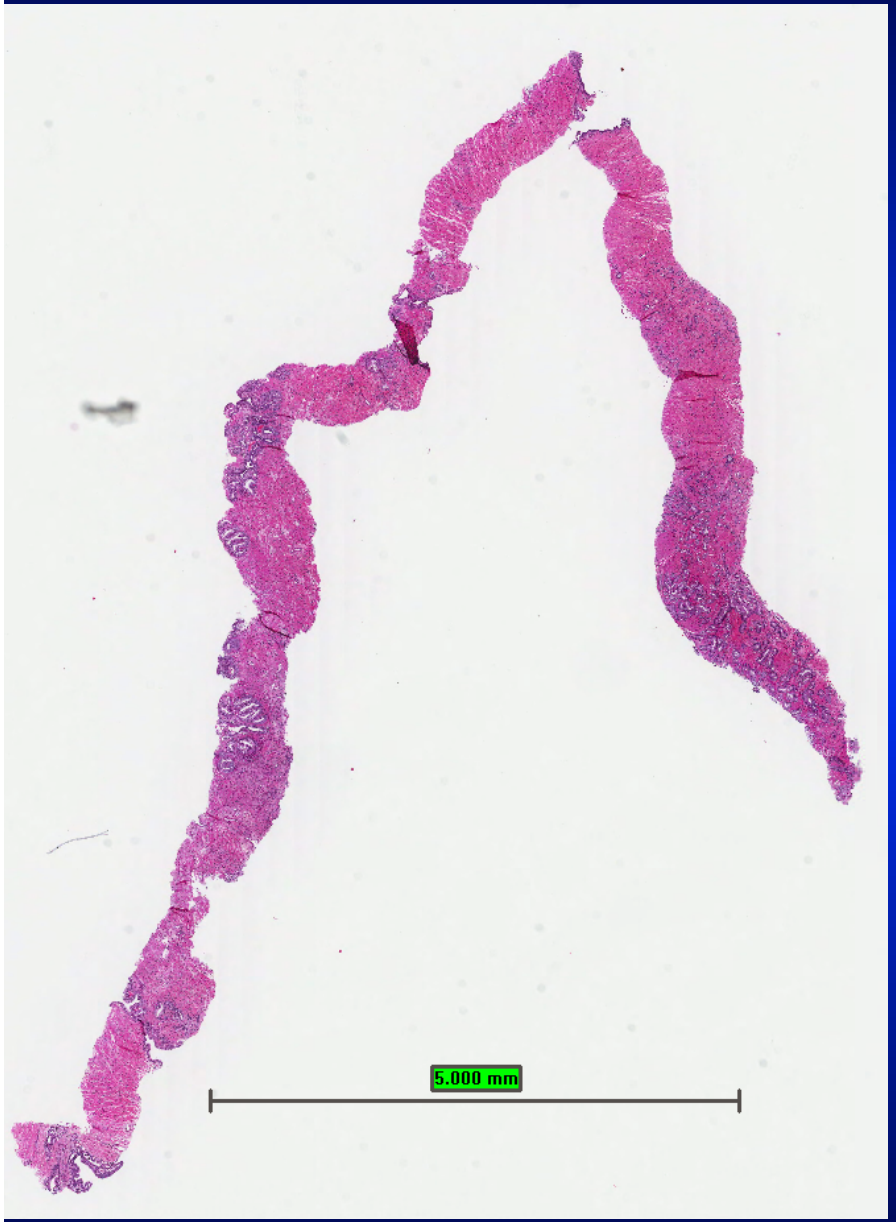
- T1c prostate cancer Gleason 3+3=6 in 5% of 1 out of 12 biopsy cores
- Patient considering
  - Active Surveillance
  - Bilateral nerve sparing radical prostatectomy
  - Radioactive seed implantation

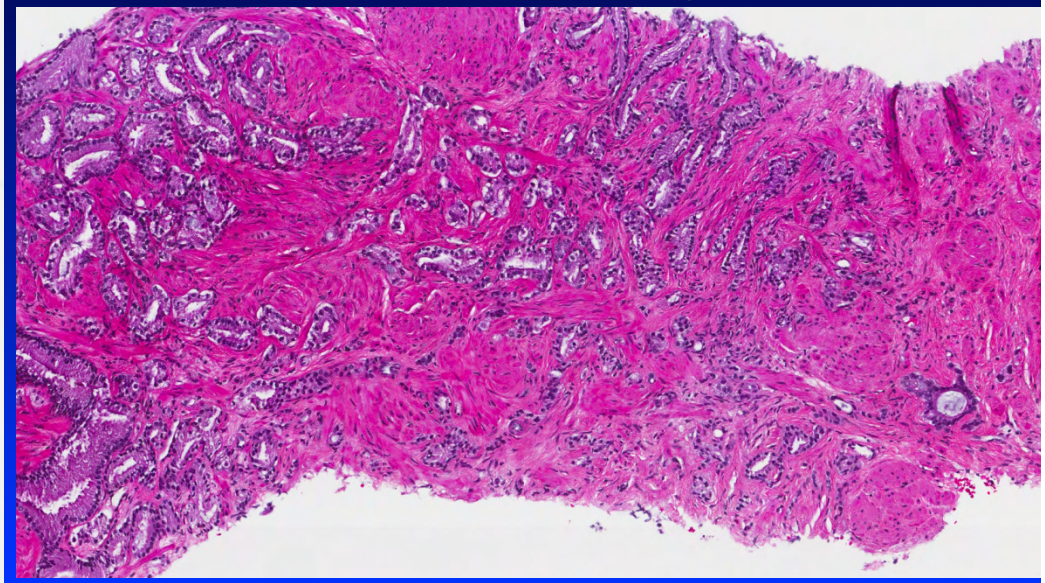
Prostate MRI

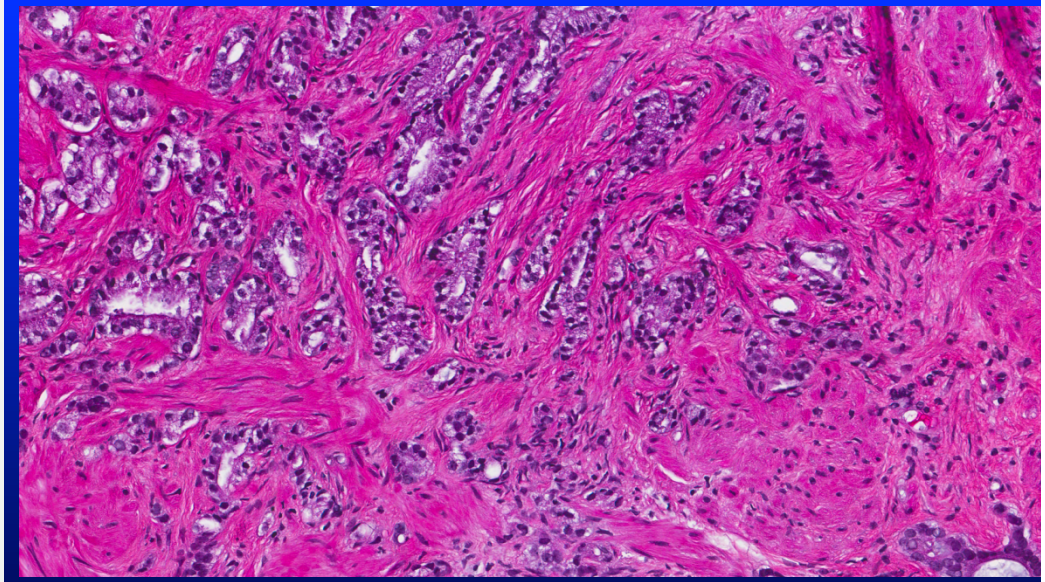


Large left mid lesion suspicious for high grade cancer and extracapsular extension into the left neurovascular bundle

MRI / TRUS Guided Biopsy







Gleason 4+4=8

57 year old healthy male

- T1c prostate cancer Gleason 3+3=6 in 5% of 1 out of 12 biopsy cores
- Patient considering
  - Active Surveillance
  - Bilateral nerve sparing radical prostatectomy
  - Radioactive seed implantation

- T3a prostate cancer Gleason 4+4=8 in 60% of the tumor specific biopsy
- Patient considering
  - Unilateral nerve sparing radical prostatectomy with extended LN dissection
  - XRT with 2 to 3 years of medical castration therapy

Summary

- Recent advances in prostate imaging and biopsy devices may for the first time hint toward an opportunity to screen effectively (disregard indolent tumors and detect aggressive ones)
- But there is much work to still be done (clinical trials)

Acknowledgements

Urologic Oncology Branch, NCI